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VIVEKANANDA GLOBAL UNIVERSITY, JAIPUR

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Vivekananda Group of Institutions

Arise Awake Achieve

Education is the manifestation of the perfection already in man". These are the words of the great philosopher and educator Swami Vivekananda. The contributions of the great people who devoted their life for the cause of education and youth have always inspired the promoters and, therefore, following the preaching of Swami Vivekananda, the promoters established VIT Campus, comprising of Vivekananda Institute of Technology and Vivekananda Institute of Technology (East), in 2008, to usher in technology revolution by using modern management techniques and harnessing potential of India. Another feather in the crown of Vivekananda Group of Institutions is Vivekananda Global University, established in the year 2012. Vivekananda Global University, Jaipur has been formed keeping in mind his teaching and mentoring ideals. The overall development of the techno-managers with a seeking spirit towards education is VGU's vision for its students. It Promises to develop as an institution with a commitment to excellence in education, research and consultancy and promote human advancement. Swami Vivekananda advocated the concept of 'total development' which includes physical, mental and spiritual. He also advocated incorporation of science and technology in curricula and laid emphasis on technical education that will develop industries. Our core values are inspired by Swami Vivekananda philosophy, and our institution is founded on his thoughts and ideas. To meet these ends, Vivekananda Global University encourage development of student's physical, mental, emotional, secular and spiritual faculties.

Perfection does not come from belief or faith. Talk does not count for anything. Parrots can to that. Perfection comes through selfless work.

Swami Vivekananda

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॥ आ नो भद्राः क्रतवो यन्तु विश्वतः ॥

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।। उतिष्ठत् जाग्रत प्राप्य वरान्निबोधत ।।

AIMS & SCOPE

The aim of "Khoj - An Interdisciplinary Journal of Research" is to promote research activities through papers and articles publication in developing streams of Science and Technology. It aims at cooperation and growth of various organizations in the field of research and development. The Journal invites original manuscripts, review articles, and short communications in any aspect of engineering, applied sciences as well as management stream, that are not published or accepted for publication elsewhere. The Editor in Chief, in consultation with the editorial committee, reserves the right to accept or reject any manuscript or discussion.

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Low Cost Processing of Aloe Vera Leaves

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Introduction

Aloe vera (Aloe barbadensis miller) is an industrial crop. Its products have long been used in health foods and for medicinal and cosmetic purposes in the form of Aloe drinks, Aloe gels, Aloe powders, Aloe capsules etc. for both internal and external uses. Aloe processing of the leaf pulp has become a large worldwide industry. In the food industry, it is being used as a source of functional foods and as an ingredient in other gel-containing health drinks and beverages.

Aloe vera contains more than 75 essential nutrients including natural vitamins (A,C,E, folic acid, Choline, B_1,B_2,B_3 (niacin), B_6, an important vitamin B_{12} etc.), 20 minerals, (including calcium, magnesium, zinc, chromium, selenium, sodium, iron, potassium, copper, manganese etc.), enzymes, protein and 18-20 amino acids. It has a wide range of medicinal applications such as wound healing, reduces blood sugar in diabetes, soothes burns, eases intestinal problems, reduces arthritic swelling, ulcer curative, stimulates immune response against cancer etc. because of its characteristics like pain inhibitor, anti-allergic, healing action, antibiotic action, anti inflammatory, antifungal, antimicrobial, digestive, energizer, nutritional, detoxification dialates vessels, fights irritation, natural cleanser, cell regeneration and rehydration of the skin.

Characteristics and Composition

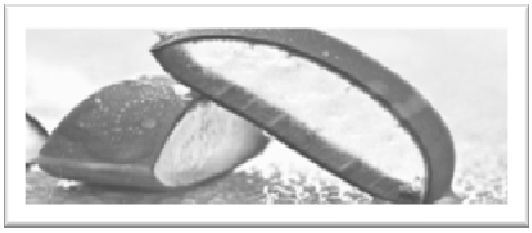

Fig. 1: Transverse section of an aloe leaf (Leaf rind and Gel parenchyma)

There are two distinct layers in aloe leaves: the green outer leaf rind and the soft, clourless inner gel parenchyma (Fig-1). The green surface of the leaves exudes a green-yellow latex-like sap called aloin. It contains phenolic compounds and has a bitter taste and laxative effect. The other layer found within the central portion of

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the leaf is gel parenchyma, a layer of colorless & tasteless tissue with many healing properties. The primary nutritional components of Aloe are B-sitosterol and mucopolysaccharides, both obtained from the inner gel.

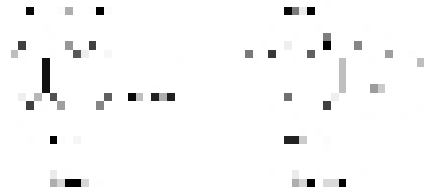

Fig 2. Two compounds present in Aloe Vera leaf

The gel contains about 98.5% water, having pH of 4.5 and also contains many polysaccharides such as Glucomannan, Acemannan etc. in active form in the leaves of Aloe Vera. Gloucomannan is a good moisturizer and mainly used in many cosmetics products whereas Acemannan, the major carbohydrate fraction in the gel, is a water soluble long chain mannose polymer which accelerates wound healing, modulates immune function and antiviral effects.

Processing Parameters

Aloe vera plants products are biologically active and hence their post harvest handling and processing needs great care. The time, temperature and sanitation (TTS) are necessary to preserve these biological activities. The TTS Aloe process not only preserves the natural biological activities of the Aloe vera but also enhances the physical stability of the finished products.

(A) Process timing

Leaves show losses of biological activity beginning at six hours following harvest when the leaves are stored at ambient temperature. Most biological activities are completely lost after 24 hours at ambient temperatures. The losses of activity appear to be the result of enzymatic activity after the leaf is removed from the plant. Infact, it has been observed that the gel once extracted from the leaf, has greater stability than gel, which is left in the leaf, showing that shipping of leaves, even at refrigerated temperature, will result in loss of biological activity. The processing must be completed within 36 hours of harvesting leaves (http://www.aloecrop.com).

(B) Process temperature

The aloe gel processing temperature also plays an important role for gel quality for medicinal and cosmetic use. For preserving biological activity, the gel is cooled to below 5°C in 10-15 seconds following gel extraction (**flash cooling**). Rapid cooling not only slows enzymatic and microbial deterioration of gel but also aids in reducing the microbial counts in the product.

Biological activity remains essentially intact when the gel is heated at 65°C for less than 15 minutes (**pasteurization**). The best method of pasteurization is high temperature short time (HTST) which exposes the gel to elevated temperatures for 1-3 minutes. Once heated, the gel is flashing cooled to 5°C or below.
The gels obtained using the pasteurization and flash cooling methods can be concentrated under vacuum without loss of biological activity (**concentration**). It is conducted under 125 mm mercury vacuum at below 50°c and must not exceed 2 minutes. The concentrated product then can be freeze dried at temperatures between -45°C to 30°C or spray dried with product temperatures below 60°C without losses in biological activity (**drying**).

Leaf Harvesting
Aloe Vera has a life span of about 12 years. The plant can be harvested every 6-8 weeks by removing 3-4 leaves per plant. Leaves are out from the plants close to the base of leaf. A yellow liquid drips from the canals (aloin cells) situated just below the rind. Leaves are stacked (cut edges facing inward) around a hollow in the ground which is lined with a plastic sheet (Fig3). The inner portion of the leaf (gel parenchyma) is used to produce various aloe gel products.

Fig.3: Harvested aloe leaves stacked around a central hollow basin lined with plastic

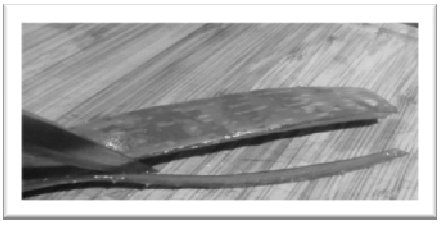

Fig.4: Leaf trimming procedure (Removal of the sides, base and tip of the leaf)

Primary Processing
When aloe vera leaves are harvested, they contain dirt and other impurities. Aloin present in leaves should be allowed to drain completely and the leaves are initially washed in sterilizing solution (a 200 ppm solution of sodium hypochlorite) and are further rinsed with water or a diluted solution (20 ppm of sodium hypochlorite)

washed air dried leaves are now trimmed (3-4^^ from tip, 1^^ from base and side sharp spines as shown in Fig.4). The trimmed leaves can now be filleted either manually or mechanically.

Secondary Processing

It involves processes like peeling of leaves, cutting of leaves into small pieces, grinding or squeezing of leaves, filtration of extracted pulp etc.

(A) Peeling of Aloe vera leaf

The removal of outer skin and rind is the most tedious operation due to the shape of the Aloe vera leaf. Precautions need to be taken to avoid contamination of inner part with exudates secretion to maintain purity of products. In manual filleting method the rind is removed by using sharp knife keeping anthraquinone level low, but in the process the most of the mucilage is left on the working table. The knife is introduced into the mucilage layer below the green rind to remove top rind and similarly the bottom rind is removed (http://www.bonasana.com).

(B) Mechanical filleting

Mechanical filleting takes place on a conveyor belt, equipped with rollers and blades. Initially, the leaf (upper surface facing downwards) is passed over a blade mounted on a table. The upper rind is cut away in one swift movement. The exposed gel surface is then longitudinally sliced from the upper to lower surface but not completely through the lower rind surface so that the curved lower rind becomes flat. The lower rind can now be easily removed by passing it over the blade as before.

The next step in gel processing is the removal of cellular material from the gel. The gel is liquidized as in fruit juice industry and filtered to remove cellular material. The liquid gel is obtained, only after the removal of fibre. For the long term storage the gel is mixed with activated charcoal @0.05% for purification and then filtered to ensure that any anthraquinone compounds in the gel are removed.

(C) Whole leaf processing

After primary processing the leaf is cut into sections and ground into particulate slurry. The material is then treated with chemicals, which breaks down the hexagonal structure of the fillet releasing the constituents. Mixing of active charcoal and vacuum filtration is required which is a cumbersome process and a time as well as power consuming one.

(D) Roller squeezing

In this method the Aloe vera leaf is passed between two parallel rollers rotating in opposite directions at different speeds. The pair of rollers with variable apertures are arranged to accommodate the varying width and thickness of the Aloe vera leaf. The purity is not maintained in this method as there are chances of mixing of outer exudates with the inner pulp.

(E) Aloe vera leaf splitter

Aloe vera leaf splitter is very advanced method of peeling in which, leaves are splited by mechanical machines that simulates hand filleting operation. A thin wire is used to split the Aloe vera leaf, which can be placed at varying distances from the vascular bundles. The wire is allowed to go too close to the rind; the extracted gel will contain more anthraquinone as well as more of the mucilage, if it is too close to gel fillet, and then less anthraquinone as well as less mucilage will be obtained. The cost involved in the process is, however, is too high.

(F) Low cost technology for Aloe vera processing

A low cost Aloe vera peeling machine, developed in Mechanical Engineering Department of Vivekananda Institute of Technology (VIT), Jaipur is used to peel out the rind from the leaves before feeding in juicer unit. The complete processing unit consists of an Aloe vera peeling machine, a pulping machine, an agitator for thorough mixing of preservatives and a juice storage tank (Fig.5). As pure gel slice is obtained after separating out the rind, filtration of the extracted juice becomes very easy and fast resulting in production of pure clear Aloe vera juice at a much higher processing rate. The cost of a 0.5 ton/day capacity plant (V.I.T. design) comes out to be only about Rs. 90,000 as against same capacity roller squeezing unit (about 5 lac) and whole leaf processing unit (about 7 lac).

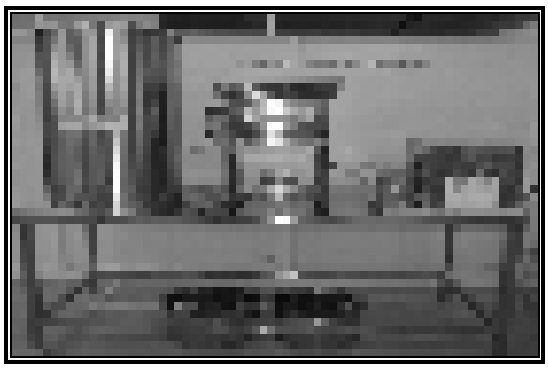

Fig.5 Low cost Aloe vera processing unit developed at V.I.T.

Stabilization of Aloe vera Gel

Aloe vera gel, like natural juices, is an unstable product when extracted and is subjected to discoloration and spoilage from contamination by micro organisms. The preservatives (sodium benzoate) and pH stabilizing agents (ascorbic and citric acid) are thoroughly mixed into the batch. Potassium sorbate is added because of the increased nutrients and sugars to prevent mold and fungus growth.

Quality Parameters

The quality parameters such as fibre content, viscosity, refractive index, optical density and total soluble solids play an important role in judging the quality and purity of extracted gel from Aloe vera leaf.

(A) Fibre content

The difference between crude gel recovery and pure gel recovery gives the amount of fibre in crude gel. More fibre content suggests poor filtration operation. The fibre content of Aloe juice is generally 0.074 to 0.088 % of fresh weight of pulp.

(B) Viscosity

It indicates gel quality in terms of activities of biological compounds. The viscosity decreases as time passes. After harvesting the viscosity of gel (mainly due to the presence of polysaccharides) is lost shortly after extraction due to enzymatic degradation.

(C) Refractive Index

It is the physical property of gel which determines the purity of gel as compared to double diluted water. It should be minimum.

(D) Optical density

It is also a physical property of gel which determines the purity of gel as compared to double distilled water. It should be minimum (normal range is 1.02 to 1.44 abs) for Aloe vera leaves.

(E) pH

The pH of Aloe vera juice should be less than 4.5 (acceptable value is 3.5 – 4.5).

Important Products

Aloe juice and Aloe gel are widely used products of the Aloe vera. It is also being used in fruit juices, beverages like tea, milk, ice cream and confectionary besides cosmetics and toiletry industry for the preparation of creams, lotions, soaps, shampoos and facial cleaners.

Further use of Aloe powder (equivalent of 360-900 mg of dried sap) per day and peeled Aloe leaves processed in a blender after adding 500 units of vitamin C powder to each cup (**Salve**) is also recommended, Similarly harvesting of Aloe leaves, followed by crushing, forms delicious herbal tea.

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Design & Fabrication of Road Power Generation Unit

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Abstract
The meeting up the regular demand of energy, we always need to fulfill energy need through other sources. In this paper we discuss the design of system that will produce electricity without destroying the nature. This paper focused over utilizing kinetic energy generated from automobile weight. This paper focus on shifting more and more towards the renewable sources of energy, which are essentially, non-polluting. This paper attempts to show how energy can be produced, stored and used using the road transport pressure or any kind of pressure. The number of vehicles passing over the speed breaker in roads is increasing day by day. There is possibility of tapping the energy and generating power by making the speed breaker as a power generation unit. The generated power can be used for the lamps near the speed breakers and this will be a great boon for the rural villages too.

Key words: Kinetic energy, Speed breaker, Electro-mechanical unit, Non-Conventional Energy

Introduction

For reduction of carbon dioxide emission, renewable energies are considered as proper alternative energy. Renewable energies mainly refer to the wind, solar, biomass and marine currents which are less harmful to environment, attracting a wide attention of researchers in design and development of renewable energy conversion systems. Although improvement of renewable energy converters is in a fast rate, the systems to extract the wasted energy in conventional energy conversion systems are not developed as much as its technologies. In many systems and processes, dissipation of energy is inevitable whatever renewable or conventional energy was used. For instance, as a car passes over a speed-breaker, most of car kinetic energy will be wasted as heat in it. On other hand, to ensure the security of the populated areas of streets, the speed-breakers are required, whatever we used electrical cars or the cars consuming gasoil. There are numerous similar cases which such vast energies are wasting. Like an elevator during going down, a car during going down on a sloppy street, where regardless the used type of energy or efficiency of systems energy is systematically wasting. It is mainly due to condition that

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the systems are operation in it. In this paper, we focus on the fixed speed-breaker at the streets since a high amount of vehicles kinetic energy is wasting there. There are thousands of crowed cities with enormous flow of vehicles offers high amount of energy can be considered as near to urban resource of energy. Also, extraction of such energy allows eliminating of transmission system between the remote areas and urban area for lightings purposes. There is a little literature about extraction of kinetic energy from flow of vehicle in the streets. There is so little and invalid literatures in generation of electricity by speed breakers that but the most common approaches can be seen in these proposed systems, mostly small radial flux generators with ineffective topologies have been employed. Therefore it is necessary to design a suitable and efficient topology for design of an energy conversion system for extraction of kinetic energy of vehicles. This paper presents a novel speed-breaker generator (SBG) for extraction of kinetic energy of vehicle flow in the street. This device converts the kinetic energy of the vehicles into electric energy. This is done by moving plate installed on the road, this plate take the stroke motion of the vehicles and convert it to the rotary motion by crank mechanism and it generates the electricity.

Literature review

The energy crisis is a great bottleneck in the supply of energy resources to an economy. The studies to sort out the energy crisis led to the idea of generating power using speed breaker. Firstly South African electrical crisis has made them implemented this method to light up small villages of the highway. The idea of basic physics to convert the kinetic energy into electrical energy that gone wasted when the vehicle run over the speed-breaker. Since then a lot has been done in this field. The idea caught our working team and decides to develop such a project that will produce more power and store it for use at night time as it proves to be a boon to the economy of the country.

Proposed System Design & Operation

A .System design & configuration

When automobile vehicle are running on the specialized Speed Breaker. This will create pressure on the pressure leaver which is kept under specialized speed breaker. As a result flywheel will rotate and this rotation of the flywheel will cause the DC generator to produce electricity. This electricity can be stored by a rechargeable battery by charging the battery. The produced or stored electricity is used for lighting bulb during night time on the road side.

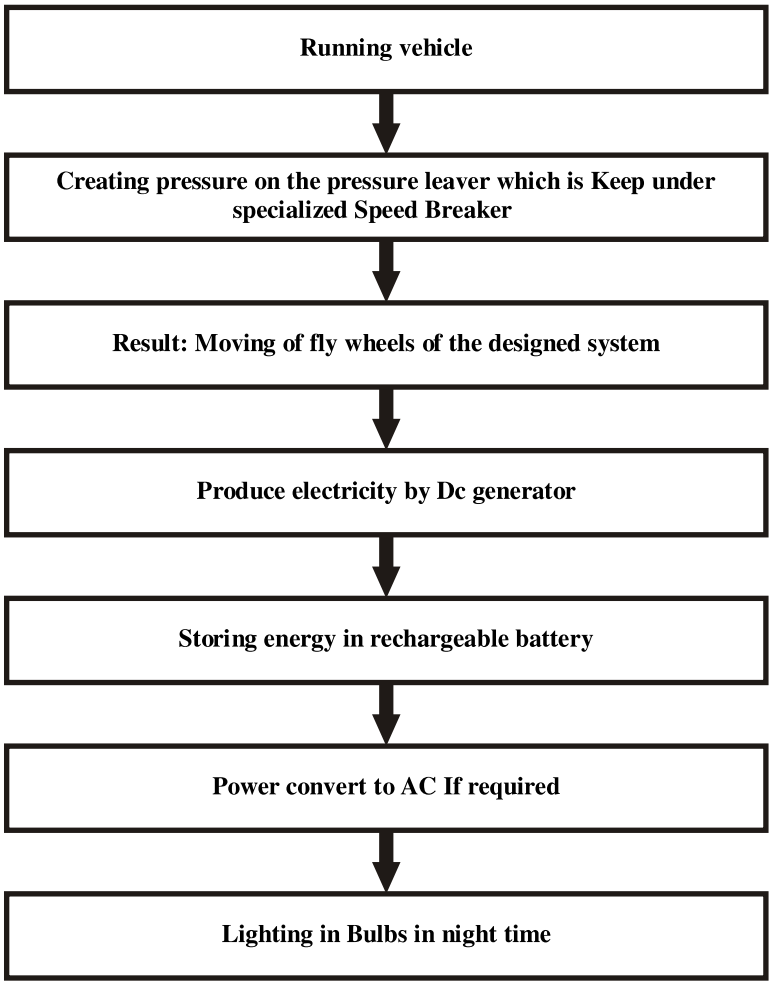

Fig.1 Flowchart of the whole system operation

B. Project Electrical Circuit Diagram

Switches that can be turned to different positions to make a connection with the contacts in that particular position. A rechargeable battery, storage battery, or accumulator is a type of electrical battery. It comprises one or more electrochemical cells, and is a type of energy accumulator. It is known as a secondary cell because its electrochemical reactions are electrically reversible.

Rechargeable batteries come in many different shapes and sizes, ranging from button cells to megawatt systems connected to stabilize an electrical distribution network. Several different combinations of chemicals are commonly used, including: lead–acid, nickel cadmium (NiCad), nickel metal hydride (NiMH), lithium ion (Li-ion), and lithium ion polymer (Li-ion polymer). When electricity is produced in DC generator, current passes through the rectifier and rechargeable battery is charged. When power is needed during the night time, selector switch is on and rechargeable battery supplies required power.

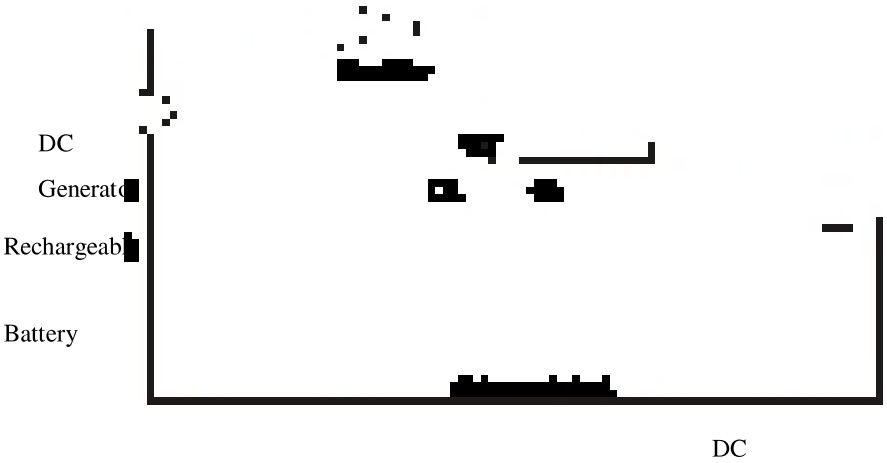

Fig 2: Project electrical circuit diagram

C. Model of the designed project

Fig 3: Model of the designed project

When pressure lever is pressed the flywheel will rotate by chine sprocket gear mechanism, it will force to rotate the DC generator because DC generator and flywheel are in same shaft. DC generator will produce electricity by the rotation of armature coil and generated electricity will be stored in a rechargeable battery. This electricity can be used later for lighting bulb during night time on the road side.

CALCULATIONS and RESULTS

Calculation of input power output power and efficiency input power calculation

$N_1=N_2=2$
$T_1=19$
$T_2=56$
$T_3=15$
$N_3=?$

Gear ratio between gear 02 & gear 03

$N_2/N_3=T_3/T_2$

$2/N_3=15/56$

$N_3=2*56/2$

$N_3=7.5$ rounds

Advantages

- Generation of power without polluting the environment.
- Simple construction, mature technology and easy maintenance.
- No fuel transportation required.
- No consumption of any fossil fuel which is non-renewable source of energy.
- No external source is needed for power generation.

Conclusion

In coming days, it will prove a great boon to the world, since it will save a lot of electricity of power plants that gets wasted in illuminating the street lights. As the conventional source are depleting very fast, then it's time to think of alternatives. We got to save the power gained from the conventional sources for efficient use. So this idea not only provides alternative but also adds to the economy of the country. Now vehicular traffic in big cities is more, causing a problem to human being. But this vehicular traffic can be utilized for proper

generation by means of a new technique called “power hump”. It has advantages that it does not utilize any external source [6].Now the time has come to put forte this type of innovative ideas, and also researches should be done to upgrade its implication. In future, if the flywheel speed control device and voltage protection devices are added with large generation process, it would be a model all over the world .After some modification of the designed project, the efficiency of the whole system can be increased by increasing the capacity of the generator and applying more weight.

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Energy & Sustainability In Engineering System: Green building

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Abstract:
We know that buildings are developer of greenhouse gases as well as consumer of energy. According to survey, we found that buildings produce approximately three main drastic components in the surroundings are carbon dioxide, sulphur dioxide and nitrogen oxide. The growing countries like India and china are main developer of greenhouse gases and continuously manufacture of non-green buildings which regularly effect on environment and produce toxic gases. The big factories, mines and others man made sources produce large number of vigorous molecules. This challenging task has led to introduce the green building concept. Green buildings are the vital role to reduce the greenhouse gases from the buildings. The green building practice complements the classical building design concerns of economy, utility, durability and comfort. It emphasizes on the renewable sources like solar, active solar and photovoltaic equipment. Green buildings maintain the value of renewable sources and reduce the energy loses.
It reduces the global degradation of ecosystem. This major step has been improving energy &environmental resources as well as focusing to convert eco- friendly buildings. This paper tries to focus on general aspects of green building like selection of material, design of buildings and performance and energy efficiency.

Keywords: Greenhouse gases, renewable, economy, material, performance, eco-friendly, comfort, durability, vigorous

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Introduction:
Nowadays, we see that buildings have been rapidly increasing which emitted vigorous and catastrophic gases like carbon dioxide and nitrogen dioxide. In research, we found that 40% carbon dioxide released from conventional buildings. After occur this problem green buildings has been implemented in practice or used to modified structure of buildings, maintain the resource efficiency and sustainability. It emphasis on reducing waste and increases employee productivity.
Energy dwindles due to grove of urban areas, population boosting, intensive growth of IT sectors. Energy consumption across world is 33% of per square foot of space. International Panel on Climate change (IPCC) concludes co2 emission from

buildings may be increase 8.6 billion tonnes in 2004 to 5.6 in 2030. But we can control on energy degradation to take steps on improving our non-conventional and equipment's, as ventilation, CFL, LED and other renewable sources. Green building is prime choice for corporations, institutions, government organizations and other business tycoons. Green building concept typically focuses on the optimization of energy efficiency.

Some useful aspects for building sustainability-

1. Environment rapport
2. Health concern
3. Material effectiveness
4. Labour expenditures
5. Maintenance level

Selection of Material

Selection of material is a concern area of Green building. Material is physical entity which describes the part of exterior and interior of building. In present time different materials use in building which have particular objectives and multifarious need. Selection of material has been analysed through the Analytical Hierarchy Process (AHP) model. Selection of material is not game, it requires lot of practices and methods as well as we should have research wing to operate this area with Engineers, researchers and scientist.

(A) Some basic properties of material

There are different values and parameters of selection of material are:

1. Material should be manufactured from agricultural waste and it would be reusable.
2. Material quality should have durable.
3. Material should be low fugitive.
4. Material should not be damageable for ex. effect on environment or may be depleted ozone layer.
5. Material should be sustainable.

(B) Factors

1. Working sources should be renewable and natural just as Bamboo and wood.
2. Material will be recycled as well as degrade the consumption on raw material. For ex. Cellulose insulated material, plastic materials.

3. Product could have calibre to sustain in particular life and less require for maintenance.
4. Embodied energy should be properly used in application for installing, transportation and productivity.

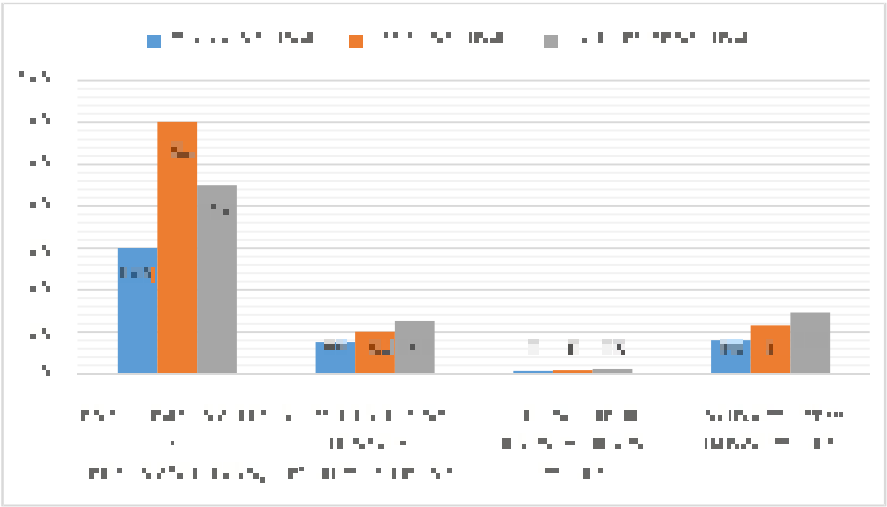


Fig1: Representation of Wood, Steel design

Note: Above graph is copied and values are approximate so it is using to show only values.

Design and Rating of Green Building

Designing is a basic part of any building. It is used to frame work on structure of green building. Design of green building depends upon the selection of material. Some factors which concerning about like as follows:
1. Green building is based on the ECBC (Energy Conservation of Building Code).
2. Design should be fully focused on the climate point of view and exploring of sunlight.
3. Building has great extent of efficient.
4. Water unit should be lower temperature rate of microclimate.
5. Direction & orientation of building should be N-S.
6. Design should be as like that we can use low E glass and outside shading.

- US and other countries has been trying to organise better design and they also made some rating and models which tests the designs, in popular one of this model has been considered as LEED(Leadership in Energy and Environmental Design) rating system.
- LEED rating system divided into different types are:
  1. LEED for new construction

2. LEED for core and shell
3. LEED for commercial interior
4. LEED for home

- LEED system used to for giving marking points to celling and wall purposes as follows :

For Wall

1. Exterior walls used for insulation as well as insulated concrete form which helpful to optimize the energy performance. In which LEED marked 10 points if the performance is above 42 percent.
2. If we are using10 to 20 percent recycled products then LEED gives 1 or2 points.
3. Considering manufactured material, it contributes the 1 or 2 LEED points.

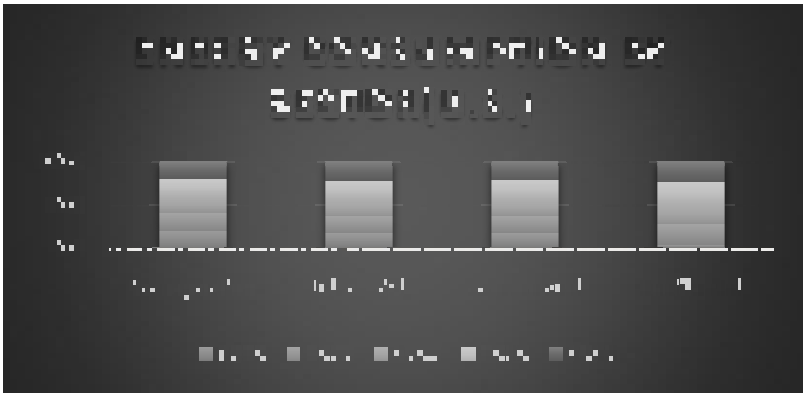
Rating System

Rating system is used to facilitate the marking criteria of buildings and their designs. Rating system uses in green building to check out the values of material and resources use in it. Rating system helps to compete in the market ground and used to change the consumers mind. Green building rating fascinated to achieve market standard. Good rating system improves our quality of green building.
There are some countries which uses their own rating system:

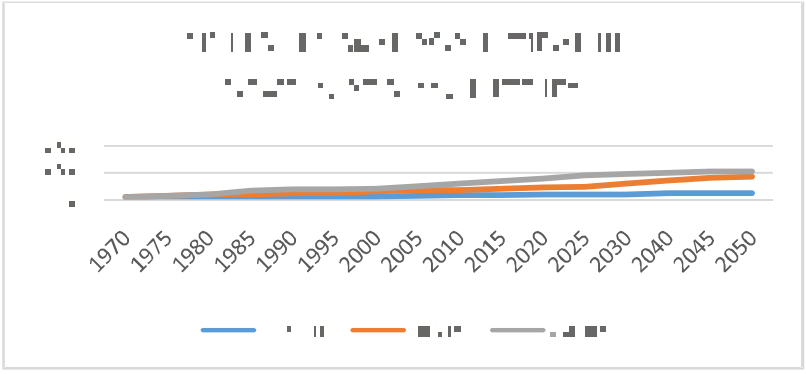
Country names	Rating systems
US	LEED, Green Global and Energy star
Australia	AGBR, Green star
Canada	LEED-Canada
Europe	European Energy rating system
Hong Kong	HK-BEAM
South Korea	Green Building Council
India	GRIHA

Energy Efficiency of Green Building

Energy consumption rises time to time in developed countries due to propulsion explosion and overrated using of energy consumers. Factors of consumption due to equipment like HVAC, Geezer, water heating m/c etc.
Energy consumption has been raised since1980s and total consumption of energy approx. 33 percent and 70 percent of commercial building consumed energy.



(A) Energy vs Population rises (focusing on consumption of energy):
According to data, World population will be exceed 20 % (2000) to 70 %(2050) which great dangerous due to it will be increase great expenditure, lavish lifestyle and great urbanization.



5. Merits and Demerits

Demerits

- Higher installation cost.
- Lack of experienced skills might be greater effect on green building project.
- If certification is not reached then it will be effects on tax payment.
- Loss of faith, if building will not work properly and loses of money.
- Lack of harmony in market.
- Lack of knowledge about green building which causes far away financial institution.
- Lack of proper connection between owners and investors which not convey knowledge properly.

- Continuous pace required to maintain the standard norms.
- Selection of material could be not tested long time which effects structural design.

Merits

Green building has great advantages are:

- It enhances and optimizes energy and ecosystem.
- It reduces wastes natural resources.
- It reduces operating expenditure.
- It improves indoor air quality.
- It optimized the quality of life cycle.
- It reduces the wastages of energy and pollution.

Present Scenario of The Green Building

In present time, all the institutions, businessman and industrialists want to escape from the concrete made building; they are going to adopt green building concepts. In present time growth of green building continuously increases in India, according to data in 2006 the profit on green building would be 750crores, this would be explore to the construction market and manufactures of green products. Experts are saying that annually overall investment approx. 1000 billion US$. According to surveying growth of green building has been increased. According to GSA survey, green building proved that it had 33% less carbon emissions, used up to less 45% less energy and 13% lower maintenance costs.

Conclusion:

Growth of developing countries like, India, china and others are accepting the green building model because they want to reduce the wastages of resources and energy. They want to yield the energy efficiency more and more. Green building is better option instead of conventional building. It enhances environmental, health and community benefits. It enhances the productivity and reduces life cycle energy costs. After this concept developed, it helps to create best industrial market and growth in financial market. The industries focus on the best material, it will help to recycling methods. If we adopt the green building concept then we will see that buildings will emitted zero carbon emission.

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Use of copper slag as partial replacement of fine aggregate in concrete

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Abstract: Copper slag is an industrial by-product generated during extraction and refining of copper metal from copper ore. Presently there are limited uses of copper slag and unused quantity is dumped unattended in the landfills, which create pollution in the environment. Particle size analysis of copper slag shows that it can be a substitute for fine aggregate in the concrete during construction of rigid pavements. The principal objective of this research is to assess the possibility of using copper slag in the construction of rigid pavements.

The cement concrete so investigated can be utilized as the wearing course of rigid pavements on the low volume roads. Also concrete containing copper slag can be utilized for flooring of causeway, construction of median strip etc. Bulk utilization of copper slag in the rigid pavements can reduce the cost of construction. It might be a step towards sustainable construction of green highways.

Introduction

Rapid industrialization has result the production of huge quantity of industrial by-products. In India over the last three decades, metal industries had been developed with a great pace. There are various copper smelting industries which generate copper slag (CS) during extraction and refining of copper metal from its ore or concentrates. The slag thus produced is being dumped in the landfills. Presently there are very limited uses of CS and unused part is being dumped unattended in the landfills. Due to large production rate of different wastes and limited utilization, the stockpiling is increasing day by day. If stockpiling is continued indefinitely, it may cause serious threat to the environment and future generation. Hence there is immediate need to make bulk utilization of these wastes to ensure sustainable industrialization.

The earlier studies conducted on the utilization of various waste materials are as given in this section. A study conducted by Khatib and Hibbert[1] had shown the effect of Ground Granulated Blast furnace Slag (GGBS) and Meta-Kaolin (MK) on the strength of concrete by the partial replacement of Portland cement. The Portland cement was partially replaced with 0-80% by GGBS and 0-20% by MK. The compressive strength and dynamic modulus of elasticity (E_d) was observed to

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increase by the addition of Meta-Kaolin up to 20 % in early ages of hydration; however the compressive strength and dynamic modulus of elasticity (E_d) gets increased by the replacement of Portland cement by GGBS up to 60% in long term hydration. The flexural strength values was optimized with 60% GGBS and 20% MK.

Investigation carried out by Zelic, J.[2] had shown the ferro-chromium slag can be used as aggregate in concrete pavements. The 28 days compressive strength of M-35 concrete was increased to 57 MPa as control mix gives only 36.7 MPa. Due to various properties like volume stability, high volume mass, good abrasion resistance to wear make this slag suitable for wearing course of concrete pavements.

Taha et al.[3]conducted a study by the addition of fly ash and copper slag as a Controlled Low Strength Material (CLSM). Cubical and cylindrical specimens were prepared and cured at room temperature. Results indicated that with a good mix design, it was possible to produce a CLSM with good mechanical properties to meet desired requirements. The author studied the potential use of Cement by Pass Dust (CPBD), incinerator ash and copper slag as a CLSM. Mixtures were designed to produce a CLSM with low compressive strength (less than 1034 KPa) that can be excavated without using any mechanical equipment.

Hence there is an urgent need to carry out detailed study for the mass utilization of copper slag in the concrete so that natural resources can be preserved. The huge quantity of copper slag available prompted author to conduct the present study.

Copper slag is generated during extraction and refining of copper metal from its ore or concentrate. Presently in India only 10 to 20% of its production is being utilized in various purposes such as in the manufacture of cement, in the manufacture of ready mix concrete, as abrasive material in shot blasting and as embankment material in the construction of roads the remaining part is dumped unattended in the landfills. If stockpiling is continued then it might be a threat to the future generation. Therefore in the present study, fine aggregates are replaced by copper slag in different proportions in the concrete.

The prime objective of the research is to study the possible application of copper slag in cement concrete for utilization in various components of low volume road construction. In more detail; the objectives of this dissertation are as follows:

1.To study the characterization of copper slag in order to contribute to a better knowledge of its properties.

2.To investigate the potential use of copper slag as fine aggregate in cement concrete by partial replacement of sand.

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Methodology

In the present study, grade of concrete mix M-25 was selected which are most commonly used in the rigid pavements. The materials such as copper slag, coarse aggregates, fine aggregates and cement were tested as per relevant Indian standards. Copper slag which was procured from Birla Copper plant was investigated for various physical properties such as gradation, specific gravity and water absorption. The physical properties of coarse and fine aggregates such as gradation, specific gravity and water absorption were determined in the laboratory. The normal

consistency, initial setting time and final setting time tests for cement were carried out as per relevant Indian standard. The mix design as per IS: 10262- 2009 for concrete of grade M-25 was done by using conventional materials for a design slump of 100 - 125 mm. After that fine aggregates were replaced by copper slag with 10, 20, 30 and 40%, by weight of aggregates in the both mixes. The compressive strength at 7 days and 28 days were determined in the laboratory. The beam specimens were prepared and flexural strength at 28 days was determined for all the mixes as per relevant Indian standards (IS). Hence, total ten concrete mixes as shown in Table 2.1 were prepared and tested.

Table 2.1 Details of Concrete Mixes Prepared

Grade of Concrete	Variation in Copper Slag (% weight of fine aggregates)	Number of Mixes
M-25	0, 10, 20, 30 and 40	5

(A) Material for Experimental Investigation

(a) Copper Slag: It was procured from Birla Copper (Hindalco Industries Ltd.), Dahej (Gujrat).
(b) Coarse Aggregates: Well graded coarse aggregates (20 mm and 10 mm) were procured from local crusher situated at Gunawata,Jaipur.
(c) Fine Aggregate (river sand): It was procured from Banas River, Tonk.
(d) Cement : Ordinary Portland Cement of 43 Grade (Shree Cement) was procured.
(e) Chemical Admixture: Naphthalene Formaldehyde and PCE Mix base (SHALIPLAST HPRA CS-2)

(i) Copper Slag

The copper slag used in this research was procured from Birla copper, a unit of Hindalco industries situated at Dahej in Gujarat state. The particles of copper slag are angular with sharpe edges as shown in Figure 3.1.The specific gravity and water absorption of copper slag particles are 3.52 and 0.33% respectively as shown in Table 2.2. The gradation of copper slag and fine aggregates are shown in Table 2.3.

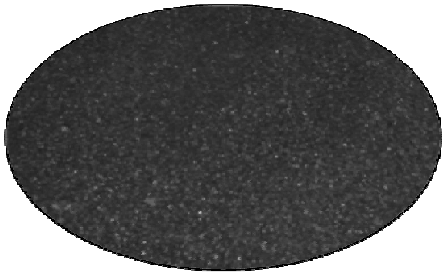


Figure 2.1 Copper Slag Particles

Table 2.2 Properties of Copper Slag

Property Test	Copper Slag
Sp. Gravity	3.52
Water Absorption	0.33 %

Table 2.3 The Gradation of Copper Slag and Fine Particles

S.No.	Sieve Size (mm)	% Passing	
		Fine Aggregates (River Sand)	Copper Slag
1	10.0	100.00	100.00
2	4.75	98.60	100.00
3	2.36	96.00	97.80
4	1.18	88.40	74.00
5	0.600	38.70	15.60
6	0.300	9.35	3.50
7	0.150	1.00	0.00

Sieve analysis results showed that the fine aggregates are well graded material, where as major fraction of copper slag lies between 600 micron and 2.36 mm size. In this study fine aggregates were replaced by copper slag in different proportion by weight of aggregates.

Chemical Composition of Copper Slag

The percentage range of various elements/ compounds by weight in copper slag as per chemical analysis report obtained from Birla Copper is given in Table 3.4. The copper slag generated by pyrometallurgical process dose not feature under this category of hazardous waste as per shedule I of Hazardous Wastes (Management,

Handling and Transboundry Movement) Rules, 2008 issued by the Ministry of Environment and Forests (MOEF), India.

Table 2.4 Chemical Analysis of Copper Slag (Source: Birla Copper)

S. No	Element/ Compound	Percentage Range
1	Cu	0.60-0.70
2	Fe	42-48
3	SiO_2	26-30
4	Al_2O_3	1.0-3.0
5	S	0.2-0.3
6	CaO	1.0-2.0
7	MgO	0.8-1.5
8	Fe_3O_4	1.0-2.0
9	As	0.02-0.05
10	Pb	0.06-0.08
11	CO	0.01-0.03
12	Cr	0.02-0.04
13	Zn	0.2-0.4
14	Ni	0.005-0.008
15	Chloride	0.001-0.002
16	pH Value	7.0-7.5

(B) Mix Design of Concrete

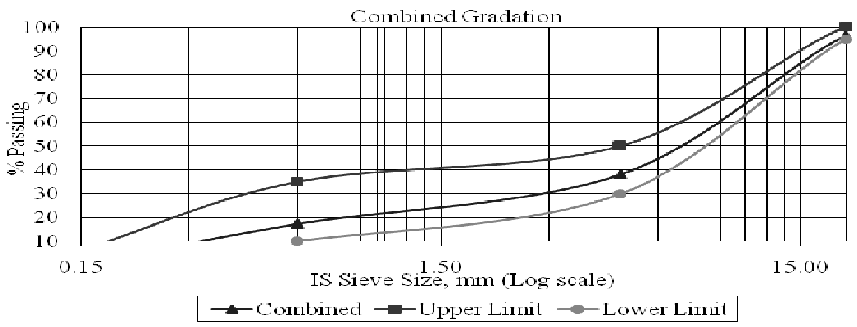
The objective of concrete mix design is to arrive at the most economical and practical combinations of different ingradients that will satisfy the performance requirements under specified condition of use. The various steps involved in the design of concrete mix as per IS: 10262-2009 are as follows:

- To determine the target mean strength ($f_m=f_{ck}+1.65*S$) where 'f_m' is target mean strength, 'f_{ck}' is charesterstic strength and 'S' is standard deviation.
- To determine the water cement ratio as per Table 5 of IS:456-2000

- To determine the maximum water content for design slump and corresponding to nominal maximum size of aggregate
- To reduce the quantity of water by using superplasticizer (Chemical Admixture)
- To determine the maximum cement content and check as per Table 5 of IS: 456-2000.
- To fix the proportion of coarse aggregates and fine aggregates
- Proportioning of CA and FA to get the desired gradation
- To find the volume of different ingredients
- To convert the volume of aggregates in weight
- To apply moisture correction and water absorption correction to CA and FA
- To calculate final quantity of mix proportion of Cement, CA, FA and Admixture and Water

Table 2.5 Combined Aggregate Gradation

Sieve Size (mm)	**% Passing**						**Combined Gradation**	**Specification Limits as per IS:383-1970**	
	Coarse Aggregates (20 mm size)		**Coarse Aggregates (10 mm size)**		**Fine Aggregates**			**Lower Limit**	**Upper Limit**
	100 %	**36.00 %**	**100 %**	**24.00 %**	**100 %**	**40 %**	**100%**		
40	100	36.00	100	24.00	100	40.00	100.00	100.00	100.00
20	89.23	32.12	100	24.00	100	40.00	96.12	95.00	100.00
4.75	0.62	0.22	12.80	3.07	98.60	39.44	42.73	30.00	50.00
0.60	0.00	0.00	0.00	0.00	38.70	15.48	15.48	10.00	35.00
0.15	0.00	0.00	0.00	0.00	1.00	0.40	0.40	0.00	6.00



Combined Aggregates Gradation

Table 2.6 Fine Aggregates blended Mix Proportion (M-25 Grade of Concrete)

Mix Name	Cement (kg)	Coarse Aggregates		FA (Fine Aggregates) (kg)	CS (C0pper Slag) (kg)	Water (kg)
		20 mm (kg)	10 mm (kg)			
FA+CS (100+0)	350	683.15	448.59	745.38	0.00	185.42
FA+CS (90+10)	350	683.15	448.59	670.84	74.54	185.42
FA+CS (80+20)	350	683.15	448.59	596.3	149.08	185.42
FA+CS (70+30)	350	683.15	448.59	521.76	223.62	185.42
FA+CS (60+40)	350	683.15	448.59	447.22	298.16	185.42

(C) Test on Concrete

(i) Compressive Strength Test

This test method is used to determine the compressive strength of concrete as per IS code. The compressive strength depends on the size and shape of the specimen, batching, mixing procedures, the methods of sampling, molding, fabrication, age of cubes, temperature, and moisture conditions during curing. Concrete cube specimens of size 150 mm as per mix proportions were casted. After testing for slump, the fresh concrete mix was placed in three layers in the mould. The compaction of concrete was done by using laboratory table vibrator for not more than for 30 seconds. The casted concrerte cubes were numbered for identification. Six specimen were prepared for every mixes.The specimens were demoulded after

24 hrs., cured in water and then tested for 7 days and 28 days at room temperature. The cube is taken out from curing tank and clean & wipe the surface of specimen with dry cotton cloth. Then the specimen is put on compressive strength testing machine in that way rough surface of side cube should be placed. Then the load is applied to the cube. The rate of loading on cube is 140kg/cm^2/min. Digital compressive testing machine of 100 ton capacity was used for compressive strength test.Three specimen were tested after curing in chamber for 7 days and remaining three specimen were tested after 28 days as per IS:516-1959 standard code for methods of tests for strength of concrete

(ii) Flexural Strength

This test method is used to determine the flexural strength of concrete as per IS Code. The flexural strength depends on the size and shape of the specimen, batching, mixing procedures, the methods of sampling, molding, fabrication, age of cubes, temperature, and moisture conditions during curing. The Flexural strength of every mix wasdeterminedfor beam of size 700 mm x 150 mm x 150 mm.Three specimenswere castedfor each mix and they were cured in chamber for 28 days. The beam is taken out from curing tank and clean & wipe the surface of specimen with dry cotton cloth. They were tested as per IS:516-1959 standard code for methods of tests for strength of concrete. Then the specimen is put on the supporting rollers horizontally. Than the load is applied to the beam by loading rollers. The load is applied @ 400kg/min. Digital universal testing machine of 100 ton capacity was used for flexure strength test. The central point loading method was used in testing.

Results And Discussions

The design of concrete mix of grade M-25 was carried out as per IS: 10262-2009 by using conventional aggregatess. The fine aggregates was replaced by copper slag from 10% to 40%, by weight in grade of concrete.

(D) Test Result on Fresh Concrete

The test results conducted on fresh concrete are presented as below:

(i) Workability (Slump Test Results)

the grade of concrete mixes were desinged for slump of (100 mm ± 10mm). In the present study chemical admixture SHALIPLAST HPRA CS-2 of SHALIMAR make was used by weight of cement.The design slump of M-25 control mix was 110 mm.

The increase trend in slump by increasing the quantity of copper slag might be due to less absorption by copper slag particles (0.33%) as compared to natural fine aggregates (1.10%). Due to which more free water is available and hence the slump value increases of the blended mixes.

Table 3.1 Slump Results on M-25 Grade of Concrete

S.No	Mix (F.A.+CS) (%)	Slump (mm)
1.	100+0	110
2.	90+10	120
3.	80+20	130
4.	70+30	142
5.	60+40	160

(ii) Test Results on Hardened Concrete

(a) Compressive Strength

The compressive strength test results for M-25 at the age of 7 days and 28 days are presented in Table 4.2.The 7 days and 28 days compressive strength results for M-25 grade of concrete is also presented graphically by Figure 4.1 The compressive strength at 7 days of M-25 increases up to 20 % addition of copper slag and then started decreasing as shown by Figure 4.1. The compressive strength at 28 days of M-25 also increases up to 20% replacement of fine aggregates by copper slag and beyond that decreases as presented by Figure 4.1.

Table 3.2 Compressive Strength at 7 Days of M-25 Grade Concrete

F.A.+C.S. (%)	Compressive Strength	
	(N/mm^2)	% Change
100+0	20.79	-
90+10	21.56	+3.70
80+20	22.37	+7.59
70+30	21.01	+1.05
60+40	20.11	-3.27

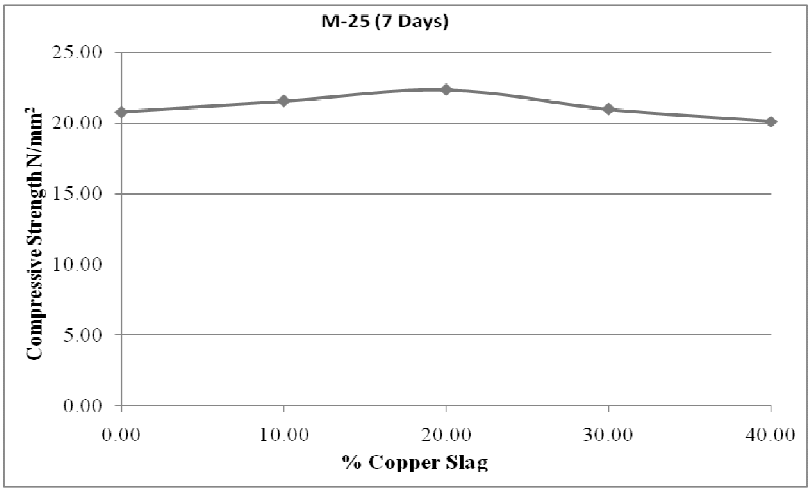
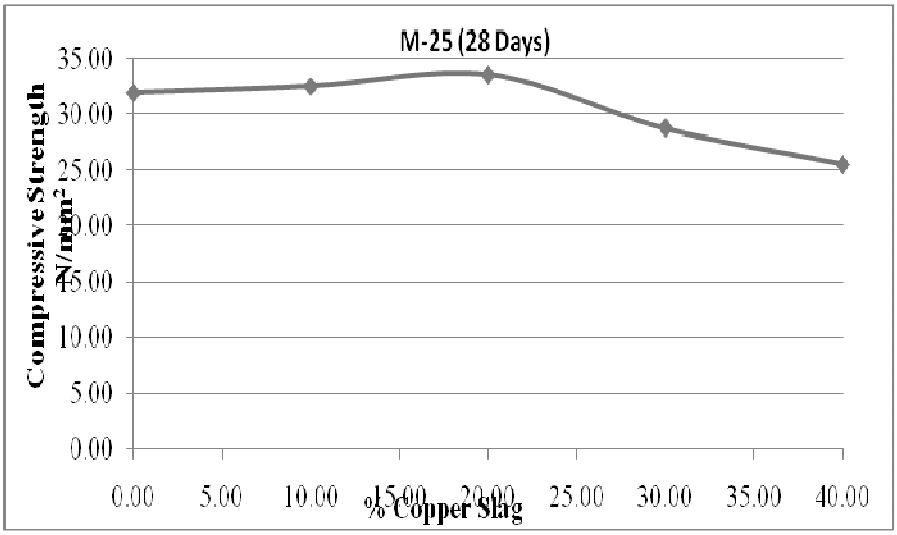


Figure 3.1 Compressive Strength (7 Days) v/s. % of Copper Slag of M-25 Grade Concrete

Table 3.3 Compressive Strength at 28 Days of M-25 Grade Concrete

F.A.+C.S (%)	Compressive Strength	
	(N/mm^2)	% Change
100+0	31.92	-
90+10	32.51	+1.84
80+20	33.56	+5.13
70+30	28.71	-10.05
60+40	25.52	-20.05



(iii) Flexural Strength

The Flexural Strength of hardened concrete at the age of 28 days for M-25 is shown in Table 3.4 along with graph in Figure 3.2

Table 3.4 Flexural Strength at 28 Days of M-25 Grade Concrete

F.A. + C.S (%)	**Flexural Strength**	
	(N/mm^2)	**% Change**
100+0	3.68	-
90+10	4.11	+11.68
80+20	4.24	+15.21
70+30	3.84	+4.34
60+40	3.42	-7.06

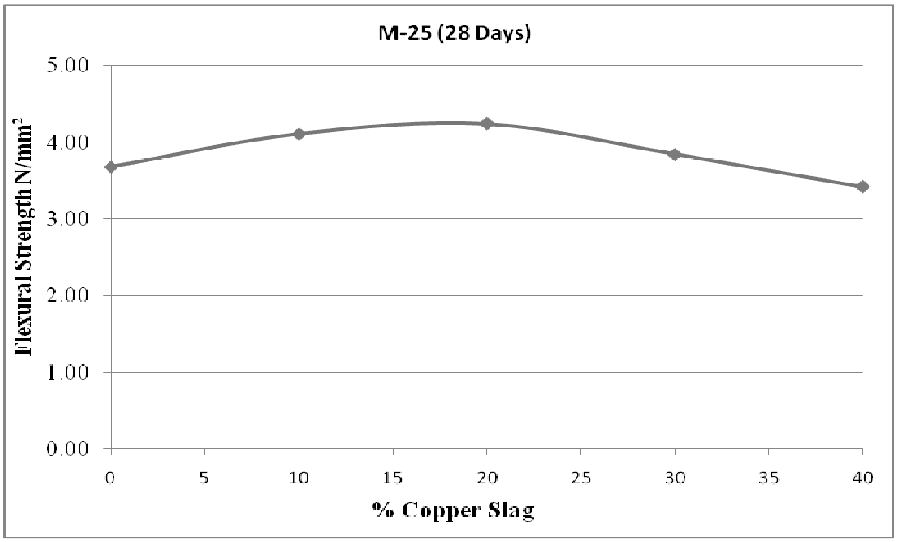


Figure 3.2 Flexural Strength (28 Days) v/s. % of Copper Slag of M-25 Grade Concrete

(iv) Density

The density of hardened concrete specimens with different percentage of replacement of fine aggregates by copper slag in M-25 and M-30 with respect to controlled mix is shown in Table 4.5 The density has increasing trend as the quantity of copper slag increases in M-25 shown by Figure 4.3.The density might be increased due to higher specific graviety of copper slag (3.52) as compared to natural fine aggregates (2.62).

Table 3.5 Effect of % Copper Slag on Density of Hardened Concrete of M-25 Grade

F.A. + C.S (%)	Average Density (Kg/ m^3) (7Days)	Average Density (Kg/ m^3) (28Days)
100+0	2531.95	2539.06
90+10	2540.25	2548.05
80+20	2543.01	2551.11
70+30	2553.98	2565.04
60+40	2563.06	2575.11

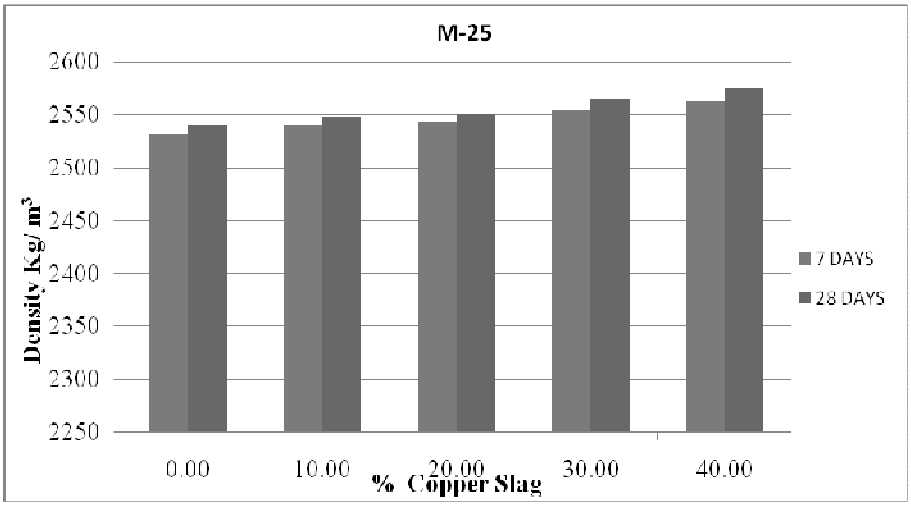


Figure 3.3 Density (7 Days and 28 Days) v/s. % of Copper Slag in M-25 Grade Concrete

Conclusions

The present study documents the findings of an experimental research on the characterization and its utilization of copper slag by the partial replacement of fine aggregates in the concrete which can be utilized in the rigid pavement for low traffic roads near copper production industries. The bulk utilization of copper slag may lead to less utilization of natural resources of river sand. On the basis of experimental study, it has been observed that copper slag is one of the most suitable waste materials which can be utilized as partial replacement of fine aggregates in the concrete. The research work can be concluded in following points as follows:

1. The technical feasibility for utilization of copper slag in M-25 grade of concrete has been carried out. The experimental results revealed that copper slag has potential for being utilized in the concrete as partial substitution of fine aggregates.
2. Copper slag particles used in this study was in the size range of passing 2.36 mm sieve and retained on 600 micron sieve. The natural fine aggregates also having particle size distribution almost in the same range. Hence copper slag particles can be directly used in the production of concrete for its practical utilization.
3. The slump values of copper slag blended concrete increased for all replacement level i.e. from 10% to 40% in M-25 mix
4. The compressive strength of M-25 grade of concrete increased up to 20% replacement of fine aggregates by copper slag and beyond that started decreasing.
5. The flexural strength test results also showed increment with 10% and 20% copper slag in M-25 concrete as compared to control mix. The flexural strength

got decreased with 30% and 40% replacement of fine aggregates by copper slag.

6. Bulk utilization of copper slag in the rigid pavements can reduce the cost of construction. Also it will solve the disposal problem of industries.

On the basis of above results, it was concluded that copper slag in M-25 grade of concrete can be utilized in the tune of 20% by replacing the fine aggregates within a radius of 50 kilometers of copper smelters. It might be a step towards sustainable construction of green highways.

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A Mini-Review on Enhancement of Anaerobic Digestion through External Addition of Enzymes and Microorganisms

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Abstract
Sewage sludge management is now becoming a serious issue all over the world. Anaerobic digestion (AD) is a simple and well-studied process capable of biologically converting the chemical energy of sewage sludge into methane rich biogas. Hydrolysis is the rate-limiting step because of the sewage sludge complex floc structure and hard cell wall. In this mini- review, the effects of biological additives like fungi, microbial consortia and enzymes on ADhave been reviewed.

Introduction
The increasing demand for better water quality for human living not only resulted in a large number of wastewater treatment plants being constructed in a short period of time, but it has also at the same time brought about an important shift in waste streams from the liquid phase to the semi-solid phase. As most municipal wastewater plants are operated by the activated sludge process, large amount of waste activated sludge (WAS) has been generated that require proper treatment before disposal (Huo et al. 2014). WAS produced is a problem with growing importance because of its huge production, potentially environmental risk and high cost for disposal. Thus, it is essential to develop proper treatment processes to mitigate this problems.Anaerobic digestion (AD) is considered to be the most energy efficient method for destroying and stabilizing waste sludge and obtaining methane byproduct as a form of fuel that may reduce treatment cost. This technology has been successfully implemented in the treatment of agricultural wastes, food wastes, and sewage sludge (Feng et al. 2014). However, its efficiency is largely limited due to the relatively slow hydrolysis process (Yin et al. 2016 and Cano et al. 2015), as WAS is mainly composed of microbial cells within extracellular polymeric substances, and cell walls are physical barriers that do not permit intracellular organicsto be easily biodegraded through digestion. In previous studies, pretreatments such as mechanical, microwave, alkaline and ultrasonication

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were reported to improve the efficiency of AD by disrupting sludge membranes to release the intracellular nutrients, but extra energy or chemicals were greatly consumed simultaneouslybecause, since the dry solid content of untreated sludge produced at wastewater treatment plant(WWTP)was only between 0.5% and 3%, much of the required energy input, or addition of chemicals, were therefore unproductive since it is to the largest part water that is being treated (Gou et al. 2014) Biological pretreatment offers unique advantages comparedto chemical or physical processes as it is environmental friendly and neither causes pollution nor needs special equipment. Biological pretreatment can be done either by adding industrial or endogenous enzymes prior to anaerobic digestion processes; or by adding specific bacteria which can secrete certain enzymes (Yu et al. 2013).

Biological additives

Many attempts have been made to increase gas production during the biogas AD process, including introduction of accelerants, i.e., biological. The adsorption of a substrate on the surface of such additives leads to a highly localized substrate concentration and favorable conditions for the growth of microbes and rapid gas production in a reactor, such as a suitable pH, and the inhibition/promotion of acetogenesis and methanogenesis, etc.

1.1. Fungi

Fungi, particularly those that attack lignin, are mainly used in the pretreatment of lignocellulosic biomass for biogas production. Several fungi classes, including brown-rot, white-rot and soft-rot fungi (i.e., *Ceriporiopsis subvermispora, Auricularia auricula-judae, Trichoderma reesei*), and basidiomycete fungi (e.g., *Ischnoderma resinosum and Fomitella fraxinea*) have been used for pretreatment with white-rot fungi being the most effective through the action of lignin- degrading enzymes (e.g., peroxidases and laccase) (Sreekrishnan et al. 2004 and Zheng et al. 2014). After fungal pretreatment, a 5 to 15% increase in the methane yield was obtained (Amirta et al. 2006 and Mackulak et al. 2012).

1.2. Microbial consortium

In contrast to fungal activity, a microbial consortium mainly increases cellulose and hemicellulose availability and thus digestibility. The consortium contains yeast and cellulolytic bacteria, heat treated sludge, Clostridium thermocellum, and a mixture of fungi and composting microbes. Previous studies have reported methane yield improvements of 25–96.63% by using microbial consortia. Although the addition of homo and hetero-fermentative strains has shown positive effects on biogas yields, the combination of these strains with enzymes or bacteria or yeasts has shown even better performance. Phanerochaete chrysosporium and cellulolytic strains of bacteria such as actino mycetes and mixed consortia have been observed to enhance gas production. However, no matter fungi or microbial consortium, the challenge for a microbial agent used as an additive during AD is the strict requirements to the composition, the activity and the purity of strains and the sealing of reactors.

Therefore, the investment cost of using this type of accelerant is high which would prevent its popularization and application (Mao et al. 2015).

Three fibrolytic bacteria isolated from sheep's colon using cellulose (b), xylan (c), and lignin (d) as selective substrates. These isolates were then used both in pure and mixed culture with cattle cellulolytic bacteria (a). The highest invitro biogas and methane production was obtained from a-c-d co-culture addition. The a-c-d coculture as inoculum for invitro feces fermentation increase the overall gas production 56.36% and methane content18.09%comparedtothe natural fermentation by feces microbes. The use of celllysate as astimulating agent in anaerobic degradation of municipal raw sludge, excess activated sludge and their mixture is examined.The effect of lysateisca used by the still remaining activity of released enzymes and by the stimulating properties of other compounds that are present inside the cells. Research on anaerobic degradation of cellulosic wastes by rumen microorganisms for enhanced production of methane and ethanol has shown clear correlation between the lignin content of several wastes, natural materials and their degradability by rumen microorganism. Eleven different microbial consortia with concomitant enzymatic activity for the effective degradation of organic kitchen waste were prepared. The degradation of organic waste by the bacterial consortia was highly significant. It reduces the time span of degradation and produces no foul odor. An experiment was carried out by using three different microbial consortiums like consortia "A", "B" and "C" to find out the suitable consortia for maximum biogas generation. Consortia "B" contains trictand facultative anaerobic bacteria Bacteroides, Peptostreptococcus,Clostridiumand Propioni bacterium. C onsortia "C" contain methanogenic bacteria like *Methanobacterium formicicum, Methanobrevibacterruminantium, Methanisarcina frisia, Methano- thrixsoehngenii.* Consortia "A" containallthe8isolates. The highest methane concentration (76%) was obtained from consortia "C" containing four different methanogenic bacteria when compared to consortia "A" (23%) and consortia "B" (1%) (Christy et al. 2014).

1.3. Enzymes

Enzymes obtained from different microorganisms and plants are critical for substrate degradation by bacteria due to biochemical catalytic reactions. As a microbial supplement, enzymes can ensure the optimal growth and activity of various types of microorganisms, and therefore, biomass can be more resistant to shock loading. Enzymes have also been used to overcome drawbacks associated with the use of conventional chemical catalysts. The most commonly used enzymes include cellulase and hemicellulose. The activities of some exoenzymes, such as proteases, lipases, and chitinases, have been reported in the literature. However, in most cases, the effect of enzymes on enhancing biogas production is in alowerrangeofonly 0–34% increases in methane yieldhavebeen achieved. Inaddition,thecost of enzymes ishigh;therefore,theapplicationofenzymesin pretreatment hasbeenlimited (Mao et al.2015).

Conclusions

By adding accelerants in the AD process, the digestion performance is greatly enhanced due to the adsorption of the substrate onto the surface of the additives.Biologically pure cultures have improved degradation and dewatering properties of the sludge and increase in methane production. The high-cost of commercial enzymatic preparation make the pretreatment economically infeasible. Thus, bioaugmentation (enhancement of the endogenous enzyme or enzyme-producing microorganisms from the municipal sludge extracellular hydrolases) or inoculation of the extraneous enzyme producing stains is considered as the proper way.

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Optimal Design of Clear Water Reservoir

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Abstract
A Clear water reservoir is a storage tank used for the storage of water for the distribution purpose or used at the time of scarcity. Optimization of clear water reservoir plays a very vital role in design and execution of water distribution network .Sometimes reservoirs are also used for the storage of fluids such as hydrocarbons .Depending upon the conditions whether the tank or reservoir is on the ground, elevated or beneath the ground various design considerations are made .In this paper we are taking an example of rectangular underground water tank and will be applying particle swarm optimization one of the evolutionary technique to optimize the cost of the reservoir and thus making the design of reservoir more economical, reliable and simple.

Introduction
In the construction of concrete structures for the storage of water and other liquids the imperviousness of concrete is most essential .The permeability of any uniform and thoroughly compacted concrete of given mix proportions is mainly dependent on the water-cement ratio .It is essential to select a richness of mix compatible with available aggregates, whose particle shape and grading have an important bearing on workability .Efficient compaction preferably by vibration is essential .The quantity of cement should not be less than 330kg/m^3 of concrete .It should not be less than 530kg/m^3 of concrete to keep the shrinkage low .It is usual to use rich mix like M30 grade in most of the water tanks.
Design of liquid retaining structures has to be based on the avoidance of cracking in the concrete having regards to its tensile strength .It has to be ensured in its design that concrete does not crack on its water face .Correct placing of reinforcement, Use of small sized bars and use of deformed bars lead to a diffused distribution of cracks .Cracks can be prevented by avoiding the use of thick timber shuttering which prevent the easy escape of heat of hydration from the concrete mass .However it should be recognized that common and more serious causes of leakage in practice, other than cracking, are defects such as segregation and honey combing and in particular all joints are potential source of cracking.
Optimization of design of various concrete structures is done by using various techniques. The Water Industry is not an exception. Design is necessary in order to carry out new configurations or to enlarge existing ones to meet new conditions .Classical methods of optimization involve the use of gradients or higher order

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derivatives of the fitness function But they are not well suited for many real world problem since they are not able to process inaccurate, noisy, discrete and complex data .Thus robust methods of optimization are often required to generate suitable results.

For last decades, many researchers in the water field have shifted direction leaving aside traditional optimization technique based on linear and non linear programming and embarking on the implementation of evolutionary algorithms such as Genetic algorithms Ant colony optimization, Simulated Annealing ,Shuffled Complex Evolution and harmony search among others.

One of the evolutionary algorithms that has shown great potential and good perspective for the solution of various optimization problem is Particle Swarm Optimization .The algorithms was developed by Kennedy and Ebehart and is a multi agent optimization system inspired by the social behaviour of a group of migrating birds trying to reach an unknown destination. This algorithms with several modifications is used in the present work to find solutions for several optimization problems.PSO is similar to other evolutionary techniques in that it does not guarantee the global optimum and premature convergence to local optima, especially in complex multimodal problem .Nevertheless, PSO can be easily implemented and it is computationally inexpensive, since memory and CPU speed requirements are low.

Objective

1. To develop a program in FORTRAN language and compiling it with using FORCE 2.0 compiler for design of Clear Water Reservoir .And finding out design parameters such area of steel of each section and thickness of each section.
2. To calculate the cost of steel and concrete used in the design of reservoir by creating a program in FORTRAN.
3. To optimize the design of Clear Water Reservoir using Particle Swarm Optimization technique .And to analyse the difference in the design values.

Water Tanks in General

The water tank is used to store water to tide over the daily requirements. Water tanks can be of different capacity depending upon the requirement. Water tanks can be of different capacity depending upon the requirement of consumption. There different type of water tank depending upon the shape, position with respect to ground level etc. In general water tanks can be tanks, resting on ground, elevated tanks, and underground tanks. From the shape point of view water tank may be of several types

- Circular tanks
- Circular tanks with conical bottoms
- Rectangular tanks

Circular Tanks

Circular tanks are usually good for very larger storage capacities the side walls are designed for circumferential hoop tension and bending moment, since the walls are fixed to the floor slab at the junction. The co-efficient recommended in IS 3370 part 4 is used to determine the design forces. The bottom slab is usually flat because it's quite economical.

Conical or Funnel Shaped Tank

This tank is best in architectural feature and aesthetic this tank has another important advantage that its suitable for high staging the tank's hallow shaft can be easily built. It can be economical and rapidly constructed using slip form processing of casting .They can also be built using pre-cast concrete elements.

Rectangular Tank

For tanks of smaller, the cost of shuttering for circular tanks becomes high .Rectangular tanks are therefore used in such circumstances .However rectangular tanks are normally not used for large capacities since they are uneconomical and also its exact analysis is difficult. For a given capacity, perimeter is least for circular tanks. The walls of Rectangular tank are subjected to bending moments both in horizontal as well in vertical direction. The analysis of moment in the wall is difficult since water pressure results in a triangular load on them. The magnitude of the moment will depend upon the several factors such as length, breadth and height of tank, and conditions of the support of the wall at the top and bottom edge.

If the length is more in comparison to its height the moment will be mainly in vertical direction i.e. the panel will bend as a cantilever .If however height is larger in comparison to length the moment will be in horizontal direction and the panel will bend as a thin slab supported on the edges .For intermediate condition bending will take place both in horizontal as well as in vertical direction. In addition to the moments, the walls are also subjected to direct pull exerted by water pressure on some portion of side walls. The wall of the tank will thus be subjected to both bending moment as well as direct tension.

Methodology

- The mathematical formulas are taken from Reinforced cement concrete design by B.C. Punmia according to the design conditions.
- Computer program for the design and cost of the water tank is developed in FORTRAN language and compiled using FORCE 2.0 compiler.
- Particle Swarm Optimization technique is used for optimizing the results of design of water tank.

Design Principles Of Rectangular Water Tank

Capacity = 192 m^3

Assuming L/B ratio =3

Now, Area= Capacity/H

B= $(Area/3)^{1/2}$

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Step 1.General

There are four components of design

- Design of long wall
- Design of short wall
- Design of roof slab
- Design of base slab

The design of the walls will be done under two conditions

- Tank full with water, with no earth fill outside
- Tank empty, with full earth pressure due to saturated earth fill

The base slab will be designed for uplift pressure and the whole tank is to be tested against floatation .As the L/B ratio is greater than 2 the long wall be designed as cantilevers .The bottom one metre (>H/4) of short wall will be designed as cantilevers while the top portion will be designed as slab supported on long walls.

Step2. Design Constants

$m=280/3\sigma_{cbc}$, $k= (m\times \sigma_{cbc})/ ((m\times \sigma_{cbc})+\sigma_{st})$, $j=1-(k/3)$, $R=(1/2)\times \sigma_{cbc}\times k\times j$

Step3. Design of long wall

(a) Tank empty with pressure of saturated soil from outside

$P_a= k_a\gamma' H + \gamma_w H$

$K_a= (1-\sin 30)/(1+\sin 30)$

Bending Moment= $P_a H^2/6$

Thickness of long wall

$D= ((BM\times 10^6)/(R\times 10^3))^{1/2}$

Area of steel in long wall= $(BM\times 10^6)/ (\sigma_{st}\times j\times d)$

Distribution steel

Percentage of distribution reinforcement= 0.3-((d-100)/(450-100))

Area of distribution steel= perc.distr.reinf×d×1000/100

Direct compression in long walls

The earth pressure acting on short walls will cause compression in long walls because top portion of short walls act as slab supported on long walls.

h = 1m(>H/4)

$p_a =k_a\gamma'(H-h)+\gamma_w(H-h)$

$p_{lc} = p_a\times(B/2)$

This will be well taken by the distribution steel and wall section.

(b) Tank full with water, and no earth fill outside

$P=\gamma_w H$

$M=P\times H^2/6$

Area of steel=$M\times 10^6/(\sigma_{st}\times j\times d)$

Direct tension in long wall

$P=\gamma_w\times(H-h)$

$P_l = P \times B/2$

Area of steel for direct tension $= P_l / \sigma_{st}$

Step4 Design of short walls

Tank empty with pressure saturated soil from outside

(i) Top portion

The bottom 1m (>H/4) acts as cantilever while the remaining height acts as slab supported on long walls.

At h=1m (>H/4) above the base of short wall

$P_a = k_a \gamma' (H-h) + \gamma_w (H-h)$

M_f (at support) $= p_a L^2/12$ (causing tension outside)

M (at centre) $= p_a L^2/8 - M_f$ (causing tension inside)

Area of steel $= M_f / \sigma_{st} \times j \times d$

(ii) Bottom portion

Bottom 1m will bend as cantilever

P_a = intensity of earth pressure

$M = 1/2 \times P_a \times 1/3$

Area of steel $= M \times 10^3 / \sigma_{st} \times j \times d$

Direct compression in short walls

Though the long walls bend as cantilever it is observed that end one metre width of long wall contributes to push in short wall, due to earth pressure and its magnitude is given by

$P_{bc} = p_a \times 1$

This is quite small and hence its effect is not considered.

Tank full with water and no earth fill outside

(i) Top portion

Bottom h=1m (>H/4) acts as cantilever while the remaining height acts as slab supported on long wall

At h=1m (>H/4) above the base of short wall

$P = w (H-h)$

M_f (at support) $= pB^2/12$ (causing tension at the inside)

M_c (at centre) $= pB^2/24$ (causing tension at the outside)

Direct tension in short wall due to water pressure on the end one metre width of long wall is $p_b = w(H-h) \times 1$

$X = d-(T/2)$

Net BM $= M - P_b \times X$

Area of steel in inner face (end of short wall)

$A_{st1} = (M-P_bX)/ (\sigma_{st} \times j \times d)$

$A_{st} = P_b / \sigma_s$

Area of steel outside face (middle face of short wall)

$A_{st1} = (M_c - P_b X)/ (\sigma_{st} \times j \times d)$

$A_{st2} = P_b / \sigma_s$

(ii) Bottom portion

The bottom 1m will bend as cantilever

$M = P/6$

$A_{st} = M \times 10^3 / (\sigma_{st} \times j \times d)$

Step5 Design of top slab

L/B>2 Hence the top slab will be designed as one way slab .Assuming live load

Self weight = $t \times 1 \times 1 \times 25000$

W= Total weight= Self weight + Live weight

$M = w \times B^2/8$

$d = ((M \times 10^3)/(R \times 10^3))^{1/2}$

$A_{st} = ((M \times 10^3)/(\sigma_{st} \times j \times d))$

Distribution reinforcement

Percentage reinforcement=0.3-0.1((t-100)/(450-100))

Area of steel=Perc.rein.×t×1000/100

Step6 Design of bottom slab

If there were no sub-soil water, only nominal reinforcement would be required. However because of saturated subsoil, there will be uplift pressure on the bottom slab, of the magnitude given by

$P_u = wH_1$

$H_1 = (H + t_{baseslab})$

(a) Check Against Floatation

The whole tank must be checked against floatation when the tank is empty.

Total upward floatation force

$P = p_u \times B \times L$

Total downward force consists of weight of tank. Thickness of bottom slab is assumed.

Total downward force =weight of walls + weight of roof slab+ weight of base slab

If the total downward force is less than uplift force then projections of base slab beyond the face of vertical walls by an amount of x metres all round so that weight of soil column supported by the projection will provide additional downward force

This effective increase in downward load might be small in water logged non cohesive ground.

Now, equating the downward load with the uplift pressure considering x metres of projection value of x is found out with the factor of safety of 1.1.

Net bending moment (M) at the edge is found out due to projected earth area, uplift pressure, earth pressure (causing tension at the bottom face)

$D= ((M\times10^3)/(R\times10^3))$

$A_{st}=M\times10^3/ (\sigma_{st} \times j \times d)$

Distribution Reinforcement

Percentage reinforcement=0.3-0.1((t-100) / (450-100))

Area of Steel=%reinforcement × 1000 × t/100

Cost Estimation of Concrete and Steel

Estimation of cost of steel and concrete is done by calculating the volume of concrete and steel used in the clear water reservoir .After calculating the total volume of steel total weight of steel used is calculated by multiplying it with weight per unit volume.

Total weight of steel used in clear water reservoir = Total volume of steel × Weight per unit volume

Weight per unit volume of steel = 7850 kg/m^3

Cost of steel used in the tank = Total weight of steel × cost of steel per unit weight

Cost of steel per unit weight = 40 Rupees/kg

Further, Cost of concrete is calculated by multiplying total volume of concrete used with cost of per unit volume of concrete.

Total cost of concrete used in clear water reservoir = Volume of concrete used × Cost per unit volume of concrete.

These, Cost of concrete per unit volume of concrete depends upon the grade of concrete.

The Rates of per unit volume of concrete are as follows:

M20 3547 Rupees

M30 3185 Rupees

After, Calculating cost of concrete and steel of example problem .Variables are chosen such as Height of tank and length to breadth ratio .And for the different combinations of these values with the help of program cost of all combinations are calculated and observed.

Value of Height of tank is taken from 3.2 metres to 5 metres

Value of Ratio of length is to breadth is taken from 2 to 4.

The optimum value is observed at Height equal to 3.2 metres and Length to breadth ratio as 2 .And optimum value of cost of steel and concrete of clear water reservoir of M30 grade concrete is observed as 3,33,313.63 Rupees.

RATIO	**2**	**2.5**	**3**	**3.5**	**4**
HEIGTH (m)					
3.2	3,33,313.6	3,25,577.28	3,18,089.97	3,23,834.2	3,30,225.03
3.4	3,38,234.84	3,29,823.41	3,33,070.25	3,39,070.88	3,46,870.53
3.6	3,43,928.56	3,41,572.25	3,48,274.88	3,55,879.94	3,64,344.75
3.8	3,52,212.56	3,56,400.22	3,64,200.5	3,73,151.06	3,82,878.75

4.0	3,67,721.28	3,73,751.25	3,82,949.47	3,94,037.7	4,04,973.22
4.2	3,79,546.06	3,87,888.50	3,98,854.8	4,11,057.3	4,23,254.06
4.4	3,96,176.25	4,06,509.00	4,19,861.3	4,33,209.2	4,47,486.16
4.6	4,12,237.81	4,24,184.25	4,39,312.5	4,54,329.1	4,70,154.63
4.8	4,28,405.28	4,42,674.06	4,58,363.28	4,75,857.2	4,93,532.06
5.0	4,45,538.63	4,61,932.94	4,79,580.78	4,98,865.78	5,18,210.7

Table above shows the values of overall cost of clear water reservoir of different combinations of the values of length to breadth ratio and height of the reservoir.

Optimization

Particle Swarm Optimization

The PSO algorithms was developed by Kennedy and Eberhart and is a multi-agent optimization system inspired by the social behaviour of a group of migrating birds trying to reach an unknown destination. PSO algorithm, with various modifications, is used in the present work to find solutions for several optimization problems in water systems. PSO is similar to other evolutionary techniques in that it does not guarantee the global optimum and has premature convergence to local optima, especially in complex multi-modal search problems .Nevertheless, PSO can be easily implemented, and it is computationally inexpensive, and easy to use.

All evolutionary algorithms share two prominent features. First, they are all population-based. A certain number of individuals, grouped as a population, are used to explore the solution space and thus to find the optimum in the system .In PSO, each bird of the flock is a potential solution and is referred to as a particle. Second, there is communication and information exchange among individuals in the test population. In this framework the birds, besides having individual intelligence, also develop some social behaviour and coordinate their movement towards a destination .Initially, the process starts from a swarm of particles, in which each of them contains a candidate solution to the problem that is generated randomly, and then one searches the optimal solution by iteration. The performance of each particle is measure during a predefined fitness function, according to the problem in hand.

The *i*-th particle is associated with the following parameters-

1. Its Current location, X_i= (xi1...xiD), in a D dimensional space, D is the number of variables involved in the problem.
2. Its Best position Y_i = (yi1....yiD), reached in previous cycles.
3. Its flight velocity V_i = (vi1....viD), which makes it evolve.

In each cycle, the bird which is in the best position, Y* = max Y_i, i=1,2,3....N with N being the numbers of birds in the swarm, is identified .Then, the swarm is manipulated according to the equations-

$$V_i = \omega V_i + C_1 rand()(Y_i - X_i) + C_2 rand()(Y^* - X_i)$$

$$X_i = X_i + V_i$$

Here, *C1 and C2* are

positive constants that are called learning factors or rates; *rand()* represents a function which creates random numbers between 0 and 1 (two independent random numbers enter Equation (1)); ω is a factor of inertia suggested by Shi and Eberhart that controls the impact of the velocity history into the new velocity. The ω factor may vary from cycle to cycle. As it permits to balance out global and local searches, it was suggested to have it decrease linearly with time, usually in a way to first emphasize global search and then, with each cycle of the iteration, prioritize local search. Equation (1) is used to calculate the i^{th} particle's new velocity, a determination that takes into consideration three main terms: the particle's previous velocity, the distance of the particle's current position from its own best position, and the distance of the particle's current position from the swarm's best experience(position of the best particle). Thus, each particle or potential solution moves to a new position according to Equation (2). On each dimension, particle velocities are clamped to minimum and maximum velocities, which are user defined parameters

$$V_{\min} \le V_j \le V_{\max}$$

To control excessive random movement of particles outside the search space .These are very important parameters that are dependent on problems. The resolution with which regions between the present position and the target (best so far) positions are searched can be determined very easily. If *Vj* is too big, particles might fly through good solutions. If *Vj* is too small, the particles may not explore sufficiently beyond locally good regions and could easily be trapped in local optima and unable to move far enough to reach a better position in the problem space.

The previously described algorithm can be considered as the standard PSO algorithm, which is applicable to continuous systems and cannot be used for discrete problems. Various approaches have been put forward to tackle discrete problems with PSO. The approach we propose here for discrete variables involves plainly the use of the integer part of the discrete velocity components .This way, the new velocity of discrete components will be integer and, as a consequence, the new updated positions will share this characteristic since the initial population, in its turn, must also have been generated by using only integer numbers. According to this simple idea, equation (1) will be replaced, by

$$V_i = fix(\omega V_i + C_1 rand()(Y_i - X_i) + C_2 rand()(Y^* - X_i))$$

For discrete variables, where *fix*(·) is a function that takes only the integer part of its argument. On the other hand, it must be taken into account that the new velocity discrete values must be controlled by suitable bounds as in (3). There is, however, a singular aspect regarding velocity bounds that must be taken into consideration in order for the algorithm to treat both continuous and discrete variables in a balanced way. In this particular case, it has been found that using different velocity limits for discrete and continuous variables has produced better results.

One of the main drawbacks of PSO is that the maintenance of acceptable levels of population diversity and to balance local and global searches is very difficult and hence suboptimal solutions are prematurely obtained. Some evolutionary techniques maintain population diversity by using certain more or less sophisticated operators

or parameters. In general, the random character typical of evolutionary algorithm's features adds a degree of diversity to the manipulated populations. Nevertheless, in PSO those random components are unable to add a sufficient amount of diversity. Frequent collisions of birds in the search space, especially onto the leader, can be detected. This, in fact, caused the effective population size to be lower and the algorithm effectiveness to be consequently impaired.PSO derivative in which a few of the best birds are selected to check collisions and colliding birds are re-generated completely at random if collision occurs. This random regeneration of the many birds that tend to collide with the best birds has shown to avoid premature convergence as it prevents clone populations from dominating the search. The inclusion of this procedure into PSO greatly increases diversity and improves convergence characteristics and the quality of the final solutions

Results and Discussion

Capacity= 192m^3
Depth of the tank = 4m
Compressive strength of concrete= M30
Free board= 0.2m
Diameter of bars used= 16mm
Angle of repose of soil= 30 degree
Unit weight of soil= 16KN/mm^3
Unit weight of water= 10KN/ mm^3

Description		**Theoritical Values**	**Program Values**
Length (m)		12	12
Breadth (m)		4	4
Thickness of wall (mm)		565.69	575.68
Long Wall	Reinforcement along inner side in (mm^2)	1441.46	1416.32
	Reinforcement along outer side in (mm^2)	1897.84	1861.43
	Distribution steel(mm^2)	809.89	816.04
Short Wall	Steel along inner side at support in mm^2	1082.64	1082.59
	Reinforcement along inner side at centre(mm^2)	861.96	861.93
	Reinforcement along outer side at support in mm^2	1410.02	1412.38
	Reinforcement along outer side at centre in mm^2	1057.47	1059.28
	Distribution reinforcement mm^2	809.89	816.04
Base thickness (mm)		310.38	310.30
Reinforcement in base (mm^2)		3962.55	3967.31
Distribution reinforcement in base (mm^2)		655.89	655.79

Projection in both side of wall(m)	0.3	0.3
Roof thickness (mm)	100	55.00
Reinforcement in roof (mm^2)	1138.98	1790.41
Distribution reinforcement in roof(mm^2)	150	52.57

Conclusion

Design of water tank is a very tedious and time consuming process which also requires various formulae and calculations .Hence program gives solution to this problem. But there are little difference between the program values and manually calculated values.

In case of theoretical calculation designer initially add some extra values so the result in case of manual calculations are greater than program values .Program gives the least values for the design. So the designer should not take the value less than the program values.

In the process of optimization various results are required for different sets of values .So in the process of optimization programming play a vital role to eliminate tedious design calculations again and again .By optimizing the results the cost of clear water reservoir is reduced.

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Lab Scale Study of Wastewater Treatment Using Membrane Bioreactor

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Abstract
In recent years, membrane bioreactor (MBR) process has gained worldwide attraction and popularity for the treatment of municipal/domestic wastewater, industrial wastewater and surface/drinking water. MBRs allow high concentrations of mixed liquor suspended solids (MLSS) and low production of excess sludge, enable high removal efficiency of biological oxygen demand (BOD) and chemical oxygen demand (COD), and water reclamation. In the Present study Synthetic wastewater, similar in the characteristics to the typical medium strength domestic wastewater, 400-600 mg/L COD was prepared as influent feed. The treatment efficiency of hollow fibre membrane bio-reactor shows COD removal efficiency as 85-91 % when the HRT =12 hours at steady state. The removal efficiency was observed to be decrease with the reduction in HRT but the effect was not significant. Maximum efficiency will be 90% at 10 h HRT and 89% at 8h. The filtered COD removal efficiency of the reactor was also very high, about 88-92% in steady state condition. The MLVSS/MLSS ratio became constant at 0.8, with the passage of time.

Keywords: Membrane Bio-reactor (MBR), Wastewater treatment, Activated Sludge Process, Microfiltration

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Introduction

The lack of fresh water is becoming an increasingly serious problem in many Asian countries. The situation is aggravated further by the pollution of fresh water resources, such as lakes, rivers and ground water due to the discharge of untreated wastewater from industrial enterprises and municipal wastewater which are the main sources of water pollution in most parts of Asia. These problems have become worse since ground water reservoirs are also exhausted. Therefore attempts should be made to promote efficient strategies for cleaning the wastewater with appropriate

technologies prior to discharge. Decentralised water treatment technologies will help to purify wastewater at the source without constructing long and expensive pipeline networks and huge central wastewater treatment plants. Smaller plants especially designed for the wastewater of one residential area or industrial enterprise can thus be applied for more efficient wastewater treatment. Additionally valuables can be recovered and some water recycling and re-use can be realised. The concurrent wastewater treatment and water re-use secures the sufficient availability of fresh water (Sartor et al., 2008).

In recent years, membrane bioreactor (MBR) process has gained worldwide attraction and popularity for the treatment of municipal/domestic wastewater, industrial wastewater and surface/drinking water. MBR are considered as a good integration of conventional activated sludge (CAS) system and advanced membrane separation, thus enabling the independent control of sludge retention time (SRT) and hydraulic retention time (HRT) and retaining a high concentration of sludge biomass in the reactors. Compared with CAS processes, MBR process has great advantages including a smaller footprint, less sludge production and better effluent quality (Wang et al., 2008).

An MBR comprises a conventional activated sludge process coupled with membrane separation to retain the biomass. Since the effective pore size is generally below 0.1 μm, the MBR effectively produces a clarified and substantially disinfected effluent. In addition, it concentrates up the biomass and, in doing so, reduces the necessary tank size and also increases the efficiency of the bio-treatment process. MBRs thus tend to generate treated wastewaters of higher purity with respect to dissolved constituents such as organic matter and ammonia, both of which are significantly removed by bio-treatment. Moreover, by removing the requirement for biomass sedimentation, the flow rate through an MBR cannot affect product water quality through impeding solids settling, as is the case for the conventional process, although severe hydraulic and organic shock loads can be onerous in other respects (Santos et al., 2011).

MBRs allow high concentrations of mixed liquor suspended solids (MLSS) and low production of excess sludge, enable high removal efficiency of biological oxygen demand (BOD) and chemical oxygen demand (COD), and water reclamation. However, membrane fouling is a major obstacle to the wide application of MBRs. Additionally, large-scale use of MBRs in wastewater treatment will require a significant decrease in price of the membranes (Meng et al., 2009).

Material and Methods

2.1 Experimental Set Up

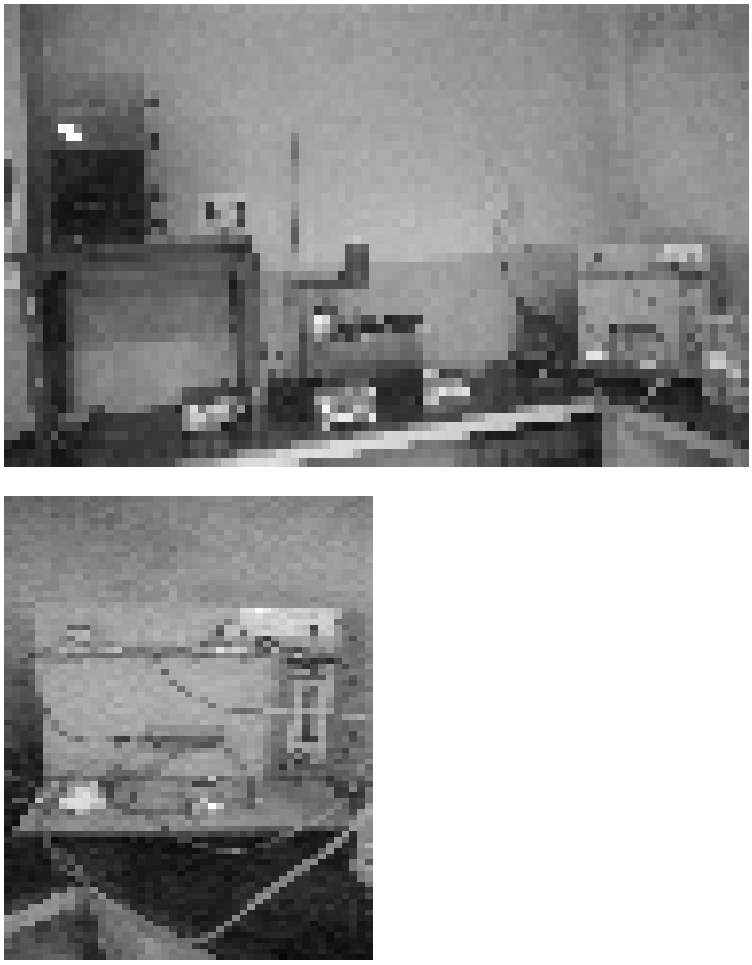

Fig. 1 Experimental set up of Cross Flow (Side stream) Membrane Bio reactor

A bench scale experimental setup, as shown in the figure 1, was used in this study. It was composed of the following units:

Feed Tank

This was a cylindrical tank made up of plexi-glass. The total capacity of the tank was 125 L. Its effective capacity was approximately 115 L due to freeboard. Though this tank had sufficient capacity for feeding the reactor at 8h hydraulic

retention time (HRT) for 3 days, yet fresh wastewater was prepared daily, as far as possible is to maintain influent characteristics within desirable range, because the basic substrate in the feed was molasses which forms particulates in solution which get settle and change the strength of solution.

Reactor

A reactor of effective capacity of 20 L was used. In order to achieve better mixing and increased contact between feed and sludge mixed liquor suspended solids (MLSS), a mixer along with a regulator to change the speed of mixer was used.

Air Compressors and Fine Air Bubble Diffusers

Portable aerators which are commonly used in household aquariums were used in the reactor. These units have a compressor and a fine bubble diffuser. The diffusers were kept at the bottom of the reactor. Dissolved oxygen (DO) concentration was maintained between 2-4 ppm for aerobic condition for growth of nitrogen and phosphorus accumulating microorganisms. These aerators also provided some mixing in the reactor.

Bench Top Hollow Fibre Microfiltration Machine

The schematic of hollow fibre membrane set up is shown in Fig. 1. The heart of the setup is the hollow fibre module. The feed is drawn by the booster pump and fed to the module by 6 mm polyurethane tube via a Perspex flange. Two pressure gauges in the range of 0 to 60 psi are attached to the upstream and downstream of the module.

A ¾" needle valve of stainless steel has been fitted in the retentate line after the hollow fibre module. This valve is used for fine tuning of pressure and flow rate through the module. A rota meter of range 0 to 50 l/h is attached to the retentate line and the retentate stream is recycled back to the feed tank. A bypass line is connected from the pump to the feed tank and a ½" stainless steel needle valve is attached to the bypass line. The permeate flows through a 5 mm polyurethane pipe into permeate collector. By controlling the bypass valve and retentate valve, one can control the flow rate and the trans-membrane pressure drop across the module, independently.

Hollow fibre cartridge

Hollow fibre membranes are extruded in an extrusion machine. Poly acrylonitrile (PAN) is used to prepare microfiltration membranes and polysulfide (PS) for the ultra-filtration (molecular weight cut off 70,000) membrane. The hollow fibres are hydrophilic. Inner diameter of hollow fibres is 0.7 mm and outer diameter 1.3 mm. Length of each fibre is 16 cm. Total 80 numbers of such fibres are packed in a ½" ID PVC pipe.

2.2 Feed Composition

Synthetic wastewater, similar in the characteristics to the typical medium strength domestic wastewater, 400-600 mg/L COD was prepared as influent feed. The initial composition of the feed is shown in table 1.

Table 1 Feed compositions

Components	Concentration
Molasses	0.5 mL/L
Urea	85.7 mg/L
$MgSO_4$	0.5 mg/L
$CaCl_2$	0.5 mg/L

The P concentration was maintained at about 1.4 mg/L (by adding 5.83 mg/ L of KH_2PO_4) during the stabilization period of the reactor

2.3 Working of the System

Fresh synthetic feed was prepared and filled into the feeding tank. The inflow was controlled at different HRT using peristaltic pump. The air diffusers serve two purposes, supply of oxygen and mixing inside the compartments to keep MLSS in suspension.

2.4 Start-up and operation of the Reactor

Reactor was started by seeding of 500 mL of activated sludge daily up to 4 months which was obtained from an activated sludge unit operational in the laboratory. Reactor was operated at low DO condition for acclimatization of phosphorus accumulating organisms. MLSS was kept in 3000-4000 mg/L range. Reactor was initially started at 12h HRT. In 51 days it attained pseudo steady state and at that time COD removal efficiency was at about 91%. Then HRT was reduced from 12h to 10h. Reactor reached pseudo steady state at 10h HRT in next 45 days when COD removal efficiency was about 90 %. Then HRT was further reduced to the working HRT of 8h. Reactor attained pseudo steady state at 8h HRT in next 30 days.

2.5 Sampling and Analysis

Daily samples were taken from influent, effluent and reactor and analysed according to Standard Methods (APHA, 2005).

2.6 Cleaning Process in Experiments

At a regular interval, membrane was first washed using tap water several times and retentate is thrown away. A feed tank was filled with distilled water and the

filtration machine was started in recycling mode for half an hour i.e. permeate is allowed to flow back to the feed tank. Then membrane permeability was measured. If the permeability of membrane was not observed same as that initially, it was then cleaned for half an hour with 4% sodium hypochlorite solution in the feed tank.

Results and Discussion

3.1 Removal Performance of Rector

Figure 2(a) shows the COD removal efficiency of the reactor at different HRTs. Overall about 90% removals was obtained. It can be seen from these figures that there was light decrease in the efficiency when HRT was reduced from 12h to 8h. COD removal was further analyzed by filtering effluent samples and results have been shown in Figure 2(b). This indicates that the quality of effluent from membrane resembles more or less that obtained by filtration. Overall, significant increase in COD removal performance was observed with the passage of time, as shown in figure. COD removal efficiency was almost 91% when the HRT was 12 hrs which it attained after 25 days, while filtered COD was around 92%. When the HRT was decreased to 10 hrs then efficiency decreases to 90% while filtered COD efficiency was 91 %. The reason for decrease in the efficiency of COD was that the amount of Flux passing through membrane increase which reduces the resistance for removal of impurities in the membrane. COD removal efficiency for the reactor at HRT 8hrs was 89%.

MLSS was maintained between 3000-4000 mg/L by changing recycling ratio. MLVSS as percentage of MLSS was observed in the range of 80-93% which is very high. This may be due to the biological characteristics of synthetic feed. The variation of MLSS, MLVSS and ratio of MLSS and MLVSS are as shown in the figure 2(c). As per the trend line, it's clear that the ratio of MLVSS to MLSS decreases with the passage of time and the ratio become constant with time for different HRT. This may be due to better quality of biomass formed with the passage of time.

Figure 2(d) show the variation in the F/M ratio which goes on increasing due to increase in the recycling ratio and HRT**.** It ranged from 0.2 to 0.45 /day**.**

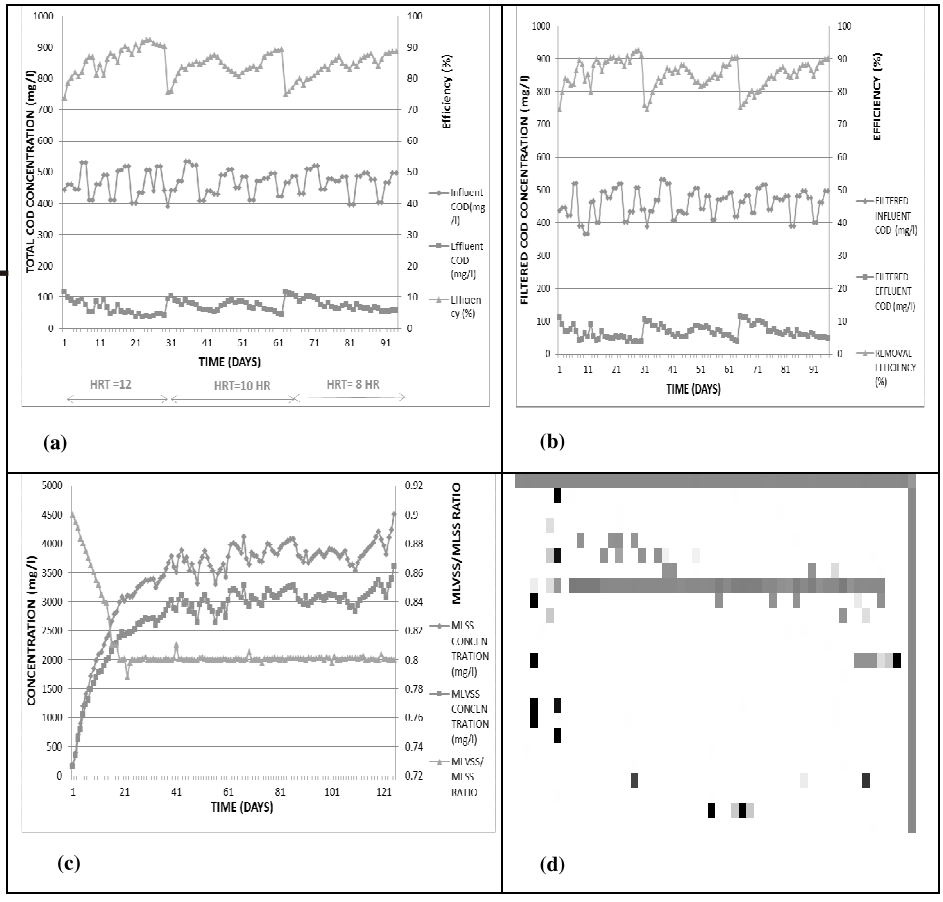

Fig 2. Variations of (a) COD; (b) Filtered COD; (c) MLSS, MLVSS and MLVSS/MLSS; (d) F/M ratio

Conclusions

COD removal efficiency of the reactor is 85-91 % when the HRT =12 hr at steady state. The removal efficiency on decreased with the reduction in HRT but the effect was not significant. Maximum efficiency will be 90% at 10 h HRT and 89% at 8h. The filtered COD removal efficiency of the reactor was also very high, about 88-92% in steady state condition. The MLVSS/MLSS ratio became constant at 0.8, with the passage of time.

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Power Quality in Microgrids Using Power Conditioner Devices

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Abstract :
The power quality in an electrical system is needed to make system reliable, for proper functioning of system and to protect system from overheating. Micro-grids are the modernized version our centralized power system. Advantage of using micro-grids with the electrical system is that it provides reliability to the system, reduction in the carbon emission and reduction in cost. We can use renewable energy resources with the micro-grids which can lead to improper functioning and poor quality factor due to presence of harmonics in the system. To overcome this effect active power conditioning devices (APC) are used which act as an interface between the renewable energy and the load of micro grid and the APC inject energy in micro grid, compensate the harmonics present and improve the power factor.

Keywords : APC, micro grids, harmonics, renewable energy resources, power quality

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Introduction

Power quality determines the quality of power being served to consumers. Power quality is often defined as the electrical network's or grid's ability to supply a clean & stable power supply. The power quality in an electrical system is important to make system reliable, to protect system from overheating, for the reduction in losses, to make system free from harmonics and prevention from flickering.
A micro grid is a small scale version of our electricity system. They are used with main grid to operate sovereignly, to make the grid strengthen their resiliency power and to mitigate the disturbances occurred in grids as they have an ability to operate continuously when the main grid falls down.

Active power conditioning devices are used in improving the power quality of an electrical system. It often refers to a device which delivers voltage in some specific ways to enable the equipment function properly. Conditioners work to smoothen the A.C. waveforms and maintain voltage over various load conditions. In this paper, we are using three phase APC's to improve power quality in micro grids significantly.
As we know, that the power demand is increasing day-by-day, there is a shortage of fossil fuels. Thus, use of renewable energy resources has become an essential source

to fulfil the electricity demand. Wind energy play a vital role in the fulfilment of demand of power in renewable energy resources.
Although we are using wind power plants, the problem of power quality occurs by the impact of harmonics present in power system from voltage and current. Harmonics are the unwanted signals due to voltage and current waveforms. Harmonic voltages and currents in an electric power system are the result of non-linear electric loads. In this paper, harmonics are of major consideration because due to this there is a wide effect on power quality in system.

Microgrid Architecture

Micro grid structure includes the interfacing, voltage control, stability and overall protection of an electrical system. The micro grid has the ability to smoothen the resilience power of the system and operate even when the system falls down.
The operation of micro grids offers various advantages to consumers i.e. improved energy efficiency, reduced environmental impact, and improvement in supply reliability, voltage control, and minimization in overall energy consumption or security of supply.
Figure1 shows the structure of micro grid. A, B and C are the feeder lines with the connection of loads. The feeders are usually of 480 volts or can be smaller. Each feeder line has several circuit breakers which are used a protection device and electronic interface which act as a power or voltage flow controllers which provides control signals to the source. The point of common coupling (PCC) is connected to the primary of transformer, act as a separation device between main grid and micro grid.

Figure 1: Architecture of Micro grid

Active Power Conditioner

Now-a-days non-linear loads are commonly present in the industries, companies, office buildings and even in our homes too. This happen due to various power quality factors such as harmonics, resonance and flickering. Thus, it can be seen as the continuous deterioration in electrical grid or power, voltage and current waveforms. For this, we use active power conditioning devices.
The active power conditioner provides current and voltage components which are used to cancel the harmonics present in the non-linear loads or supplymains.

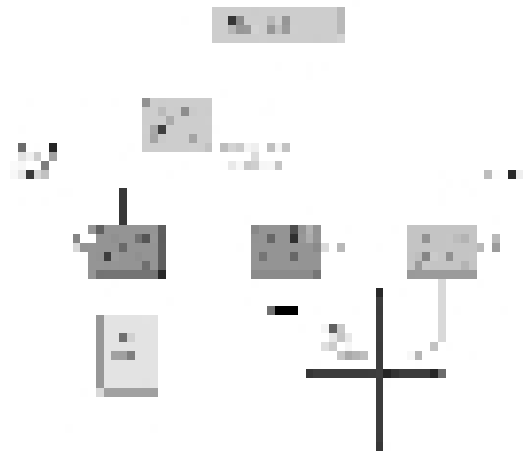

Figure 2: Active power conditioner for micro grid applications

Control of APC

Figure 3: Active power conditioner control strategy

This strategy is basically a compensation method which makes the APC control the current of non-linear loads. To design a controlling of APC, there are many techniques, considering that the grid voltage at PCC is at balanced mode. The supply voltage in a micro grid is itself distorted so the controller has to be designed according to the weakness of grid.
The controller requires a three phase grid current (ia, ib, ic), three phase voltage at PCC (va, vb, vc) and a DC voltage (VDC).
The three phase grid currents ia*, ib*, ic* can be expressed as:

Using this compensation technique we compare the different parameters like current and error. By changing the value of three phase current we can reduce the error generated due to harmonics and other affecting parameters. The Active Power Filter is a device which compensates both current, harmonics and power factor. Moreover, in three-phase four wire systems it balances the current in the three phases and eliminates the current in neutral wire.

The power stage is, basically, a voltage-source inverter with a capacitor in the DC side, which is controlled in a way that it acts like a current-source. From the measured values of the phase voltage and load currents , the controller calculate the currents of inverter which produces the compensation currents. This method requires 6 current sensors in which 3 sensors are used to measure the load currents and another 3 sensors to measure the closed-loop current control of the inverter. It also requires 4 voltage sensors from which 3 sensors are used to measure the phase voltages and another one is used for the closed-loop control of the DC link voltage.

For three-phase balanced loads (three-phase motors, three-phase adjustable speed drives, three-phase controlled or non-controlled rectifiers, etc.) there is no need of compensation of the neutral wire current, and hence, the fourth wire of the inverter is not required, which helps in simplifying the filter circuit, which reduces its cost too. Though, the power quality problems upstream to its coupling point are compensated, they should be installed as near as possible to the non-liner loads, avoiding the circulation of current harmonics and neutral wire currents through the power lines. Therefore, it is very advantageous to use small units instead of using a single high power Active Power Filter at the input of the industry, at the PCC (Point of Common Coupling – where the electrical installation of the industry is connected to the electrical power distribution system).

Simulation Results

The simulation was performed on the MATLAB/ SIMULINK package. Simulink is a software package for modeling, simulating and analyzing dynamic systems. The simulation is basically supports the linear and non-linear systems, which are modeled in continuous or sampled time. In this, the simulation of APC has been shown. The simulation results are shown according to the following power quality indicators: THD(Total Harmonic Distortion),power factor and unbalanced load.

(a) Harmonics Compensation

Fig.4,5,6 shows the currents at the PCC. As seen, most of the current required by the load is injected by the APC and the balance comes from the micro-grid.

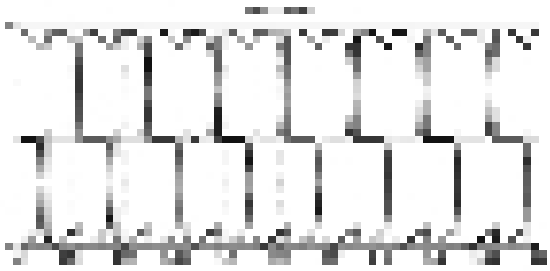

Figure 4: non-linear load current

Figure 5: source side current

Figure 6: APC side current

(b) Power Factor Compensation

This effect shows how the APC can be used to compensate the power factor.

Figure 7: before compensation

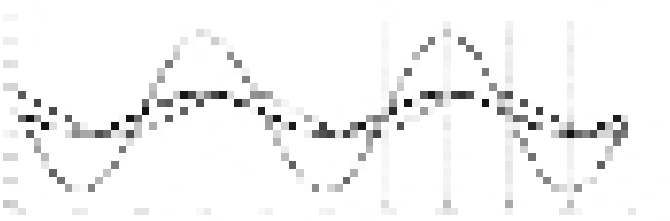

Figure 8: after compensation

Conclusion

In this paper, to improve the power quality in micro grids, an active power filter has been taken which compensates the harmonic currents present in the non-linear loads. The APC is controlled by using the control strategy which seems to be innovative which allows the line current at PCC to be balanced and sinusoidal even when there is unbalanced load condition.

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GA based Optimal DG Placement for Mitigation of Power Losses and Voltage stability Enhancement

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Abstract :
The voltage deviation from the nominal value is a major problem in the distribution system during operation of the system. Normally voltage profile of load buses decreases from source to loads at far end. With the deviation in load connected to the system, voltage profile of the load buses increases/decreases and may lead to the collapse of the system and subsequent loss of economy. Another problem in distribution system is line losses which reduces the efficiency of the system. Among the possible solutions for these problems, DG allocation is a promising one which feeds the system with additional benefits. However a non-optimal allocation of DG can adversely affect the performance of the system. This paper proposes GA based optimization algorithm to improve voltage profile of the system and simultaneously reduces the total real and reactive power losses.

Index Terms : (DG) Distributed Generator, (GA) Genetic Algorithm, (RDS) Radial Distribution System.

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Introduction

Line losses have a major impact on efficiency of power system as a considerable amount of power continuously getting lost due to line resistance [1]. Distribution systems in India are usually radial in nature due to their operational simplicity. The Radial Distribution Systems (RDS) are fed at only one point and the power flow in the RDS is unidirectional. Due to high ratio of R/X in distribution system compared to transmission system, distribution lines constitute large bus voltage deviation, high power losses and low system stability [2-4]. Hence, line loss reduction and voltage profile improvement are major challenges for the distribution utilities. Several attempts have been made by researchers to improve the voltage profile and efficiency of distribution system. In [5], a method is proposed for the placement of capacitors to compensate the reactive power in the system

More promising solutions are proposed in the literature to achieve the mentioned objectives by embedding small resources of electricity with distribution network called Distributed Generator (DG). Modern advancement in renewable technology

has pushed DG in as a probable solution for these issues [6-8]. DG is small size generators or any power source sited close to the load being served. It is also known as an onsite or decentralizes generation [9-10]. DG utilizes the local resources of energy. With the rapid advancement in the field of renewable generation utilization of renewable resources as DG rapidly increasing. Use of renewable resource saves the conventional resources and provides clean and green energy [9], [11]. The European Renewable Energy Study (TERES) concludes that by 2010, more than half capacity of renewable recourses utilized for electricity generation will be in the form of distributed generation [12].

The location and capacity of DG has a vital role in the DG allocation to the distribution system. Installation of DG at non-optimal location may increase the line losses and can further reduce the voltage profile of the system. Therefore to find the optimal location and size of DG in the system is a major challenge for any system planner [10]. There are various methods and approaches proposed in the literature for optimal allocation of DG to the distribution system. In [13], Hereford Search Algorithm is proposed based on artificial intelligent technique for optimal location of the DG. In [14], authors proposed analytical approach using a quantitative index to optimize DG location which is calculated through continuous power flow technique. In [15], a multi- objective GA is proposed in combination with Multi-Attribute Decision Making Method to optimize the location and sizing of DG in distribution system. The proposed methods in the literature show promising results. GA shows various advantages over other proposed techniques and presents itself as powerful approach for the optimization problem [16-18]. GA is a global search approach which analyzes the solution among a random set of possible solution and have an advantage that this do not require any prior information of gradient surface. For the convergence this approach utilizes genetic evolution concept of nature [10].

In this paper GA is used in the proposed algorithm to optimize DG providing active support in IEEE 33-bus radial distribution system. The main objective of the present work is to find the location and capacity of DG to reduce the system line losses and improve the cumulative voltage deviation in distribution system through DG allocation.

Problem Formulation

Interconnection of DG improves the performance of the system by reducing the line losses and bus voltage deviation, only when allocated optimally. It also serves the system with various other advantages like voltage stability enhancement, improvement in system load ability etc. voltage stability can be defined as the ability of the system to retain the bus voltage constant even in growing load situation. Advantages of DG's can be maximized by connecting DG at most suitable location among all candidate buses. Line losses and bus voltage profile are the most important parameter which affects the performance and stability of the system.

DG's are classifies by the kind of support which they provide to the system. Either active or reactive or both kind of support may be expected from DG's. DG injects the power at the load end, by virtue of that it reduces the demand of the power at respective bus location. This reduction in demand reduces the overall line losses of

the system. This injection of power also improves the balance of active to reactive power which improves the voltage profile. If this allocation of DG is not optimal it may adversely affects the performance of the distribution system.
This paper proposes GA based optimization method for DG location and its rating to reduce line losses and improvement in cumulative bus voltage profile of the system.

(a) Constraints

GA converge its solution within a search space bounded by system constraint. Following constraints for the optimization problem are considered here.

1. Active and reactive loss constraint

$$P_L^{\text{with DG}} \leq P_L^{\text{without DG}}$$
$$Q_L^{\text{with DG}} \leq Q_L^{\text{without DG}}$$

2. Voltage constraint

$$V_{bus}^{min} \leq V_{bus} \leq V_{bus}^{max}$$

3. DG size constraint

To obtain maximum benefits DG size is considered in between 10% to 40% of the source capacity.

$$P_{10\%} \leq DG_R \leq P_{40\%}$$

Solution Methodology

An optimization approach based on the (GA) genetic algorithm is proposed for this optimization problem. GA uses the concept of genetic evolution to achieve convergence and it can be utilized for both constrained and unconstrained optimization problem. GA has advantage over other conventional and modern approaches that it doesn't need to posses any prior information about objective function for the problem being optimized and it does not deal directly with the parameters of optimization problem whether it uses codes for this.
GA propagates in a search space containing random sets of 'N' possible solutions, collectively called population. Each candidate solution contains a random set of 'n' possible location for DG connection and their corresponding random DG ratings, individually called gens. GA selects the candidates for operation by their biological selection of most fit candidate by the help of fitness function. Objective variables for fitness function are 'Active power loss', 'Reactive power loss' and 'Cumulative voltage deviation', whom obtained by continuous power flow analysis of each candidate solution. GA converges the solution in iterative way by using genetic operators 'Reproduction' 'Crossover' and 'Mutation' inspired by natural evolution process. GA modifies the population of candidate solutions after each complete

iteration, according to genetic operators. This modified population is called generation [19].

(a) Objective Function

Objective function guides the search to find out the best location and size of DG. The appropriate objective function for the search is constructed as follows:

$$OF(x) = \{W_P * P_L + W_Q * Q_L + W_V * (CVD)\} \quad (1)$$

Where PL, QL & CVD are the Active power loss, Reactive power loss and cumulative voltage deviation respectively in distribution system and W_P, W_Q and W_V are the weights given to the variables. Weights to the objective variables are assigned by following relation:

$$W_P + W_Q + W_V = 1 \quad (2)$$

Weights are allocated by a random hit and trial approach. Random sets of variables are used with equal weights to active and reactive losses in different attempts. Weights for which best optimized solution is achieves are assigned to the function. Variables of objective function are obtained in following way

$$P_L = \sum_{i=1}^{n} I_a^2 R_i \quad (3)$$

$$Q_L = \sum_{i=1}^{n} I_r^2 X_i \quad (4)$$

Objective of the optimization is to improve the bus voltage profile hence to make objective function minimizing, variable to bus voltage profile is converted into cumulative voltage deviation which is a minimizing variable for the same and it can be obtained for each bus as follows:

$$CVD = \sum_{i=1}^{n} (1 - V_i) \quad (5)$$

Where (I = 1, 2, 3……n) bus of the system

For the minimization problem fitness function is as follows:

$$FF = \frac{1}{1+OF} \quad (6)$$

(b) Population

To initialize the algorithm GA requires an initial set of probable solutions called initial population. This is completely a random group of candidate solution generated by random number generator and for these candidates no prior knowledge exists.

These candidate solution consist subset consisting properties of candidate related to the DG location and sizes, known as genes. These candidates can be constructed in following ways

- In binary representation of chromosomes (candidates) value of each gene is given in their binary equivalent. The biggest issue is to decide the count of bits in which genes are formulated.
- In real coding of chromosome, property of each gene is coded in their relevant decimal values.
  In this paper real number coding is used for the representation of chromosomes. Respective to the number of DG's connected, twice no of genes are inherited in each chromosome. Half of the genes carried the location properties and rest carried the respective sizes of DG.

(c) Genetic operators

After evaluating the fitness of each candidate using fitness function, GA converge the solution by their genetic operators which are Reproduction (Selection), Crossover & Mutation. This complete evolution process is nature inspired, although it's not necessary to use all the operators. Use of operators can be modified as per requirement of the problem.

Reproduction

Reproduction operator works to concise the search space to achieve convergence by selecting the parents in descending fitness order. This operator transfer the pair of parent chromosome for the next step of evolution by giving higher priority to higher fit candidate and removes those candidates whom not satisfies the minimum fitness criteria. In this way selection ensures the propagation of best genetic material to the next upcoming generation.

Crossover

This is one of the most important genetic operator, as it shapes the new generation by performing the crossover of genetic material between two selected parents. Crossover can be performed in a way which generates the one child chromosome inherited best from both the parents. Whereas two child chromosomes can be generated after random transfer of genetic material between parent chromosomes. Generally transfer of genetic material performed by one point crossover, two point crossovers or multipoint crossover.

Mutation

This operator introduces diversity in population. This operator works at gene level for each candidate. It randomly selects a gene from chromosome and produce alteration by a specific rate. This produces the diversity in new population from older one. This helps to avoid premature convergence and leads towards global solution.

(d) Algorithm control parameters

Control parameters are applied at every step of algorithm to control the execution of the algorithm. This is necessary to control because uncontrolled evolution may lead the algorithm towards non-optimal results or may keep algorithm un-converged.

The common parameters for the genetic algorithm are Initial population size, selection rate, crossover rate and mutation rate. Other parameters can be added as per requirement of the problem. Population size defines the area of search space. Large population size posses the advantage of better convergence but may improve the time of execution.

Selection rate is defined by the fitness below which candidate marked as unfit for optimization. This helps in selection of candidate with better fitness. A higher fitness level reduces the execution time of algorithm as it selects the candidates with high value of fitness. But this may leads the situation to get premature convergence as it may drop a candidate with potential fitness which will reduce the probability to achieve global solution.

Crossover and Mutation are the most important steps of evolution. Crossover rate control the frequency of crossover operation whereas mutation rate controls the percentage of diversity introduced by operator in child chromosome. Higher mutation rate may distinct the child from rest of population.

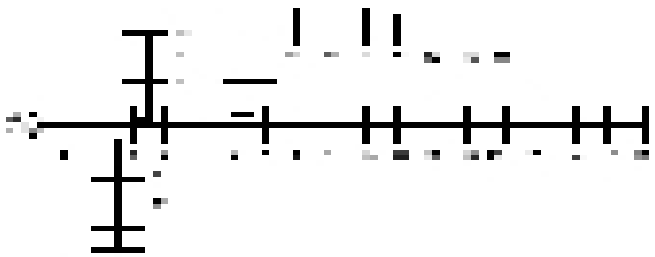

Fig.1. 33 Bus radial distribution systems

Proposed Algorithm for DG allocation

GA evaluates the fitness of each candidate by fitness function.

To initiate the algorithm, population of candidate solution is fed to the load flow program which is created randomly. 500 candidates are generated by a random generator which carries the genetic material to optimize 3 DG's in IEEE 33 bus radial distribution system. DG's are improving the system performance by providing only active power support. Fitness of these candidates is obtained by fitness function containing system performance variables that are active & reactive line losses and cumulative voltage as shown in equation (1). Weights to the variables are assigned by random pick and trial method. Different sets of weights satisfying above mentioned condition are generated by random generator with the

condition of equal weights for active and reactive power loss. The set which providing the best optimized results is finalized for final calculation.

Objective variables for each candidate are obtained by load flow analysis with every candidate solution. Reproduction operator is then chooses the fit candidates and forward them for further evolution process. Average fitness is observed for the reproduction operator by manual observation and in each iteration candidates below this fitness level are eliminated from the population.

Random N point crossover is performed to generate offspring. Gens of candidate chromosomes are interchanged by this operator and new population formed. This operation is controlled by crossover rate (0.05). Now the offspring is forwarded to mutation operator. Mutation operator randomly selects a gene and altering it by multiplying a random number. This operation is controlled by mutation rate (0.05).This operation maintains the diversity in population and prevent the premature convergence which may occur due to elimination of possible candidate at earlier stages. Fitness of this population is again evaluated and the operation is again followed in iterative way until convergence achieved. This approach is presented below in form of flow chart.

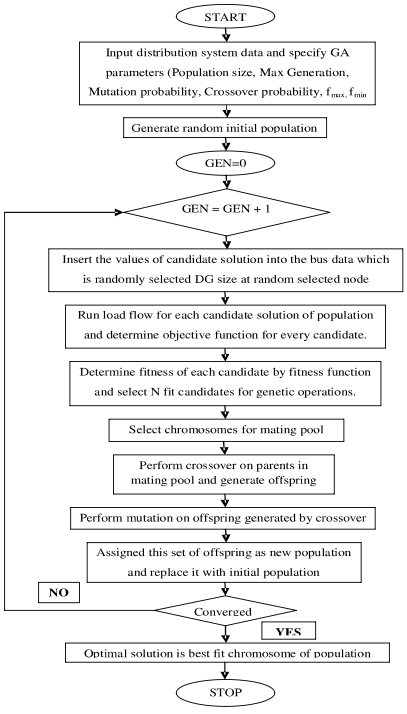

Fig. 2 Flow chart of proposed Algorithm

Simulation Result

Location and sizing of DG which is most optimal for DG location obtained by proposed algorithm. For these results distribution system performance is analyzed by load flow analysis of the system.

GA proposed optimal bus locations (3, 17, and 28) with optimal rating of (0.8256 PU, 0.2134 PU and 0.4571 PU) respectively for IEEE 33-bus radial distribution system. Initially system performance analysis is performed for base loading condition. It is observed that with the increment in load of the system, performance of the system reduces in the form of increment in system losses and reduction in voltage profile. Uniform load increment is employed to increase the load on the system and for these different loading conditions analysis is performed to evaluate the effects of DG, on the system more accurately.

Table-I presents the change in bus voltage profile of the system for the results converged by the algorithm. Approx 50% reduction in voltage deviation is observed in the system operation with the DG's in base loading condition. Further the analysis done for the 105, 110, 115, and 120 percent of loading condition. Reduction in voltage deviation in incremental loading conditions is indexed in table shown below. Fig.3 shows the comparative bus voltage profiles in between without DG base load and DG with various loading condition. This graph shows the significance of DG interconnection for improvement in bus voltage profile of the system.

TABLE I
PERFORMANCE EVELUVATION OF DG OVER CVD PROFILE OF THE SYSTEM

Loading condition	System status	Optimal Bus Location	Respective DG ratings (PU)	CVD (PU)	CVD_R (%)
100%	Without DG	-	-	1.0137	48.60
	With DG	3,17,28	0.8256, 0.2134, 0.4571	0.5210	
105%	Without DG	-	-	1.0499	47.09
	With DG	3,17,28	0.8256, 0.2134, 0.4571	0.5555	
110%	Without DG	-	-	1.0862	45.67
	With DG	3,17,28	0.8256, 0.2134, 0.4571	0.5901	

Fig. 3. Bus voltage profile of the system under different loading conditions

Reduction in cumulative voltage deviation of the system by connecting DG at optimal locations presented in Fig. 4. This fig. presents benefits of DG whether the load is increasing. Improvement in voltage profile is observed in every case of incremental loading condition.

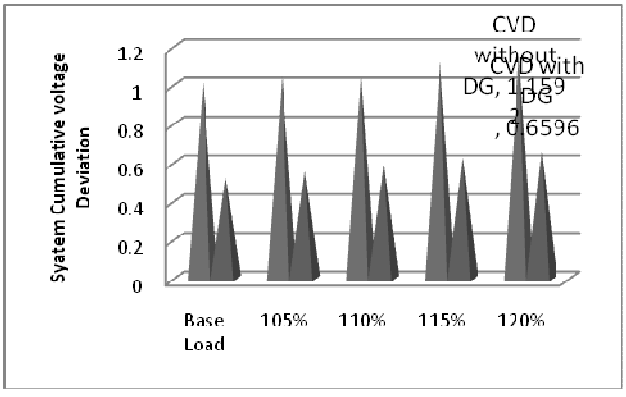

Fig. 4. Cumulative voltage profile of the system: Comparative analysis between without DG and with DG condition of the system

Table-II presents the reduction in active power losses of the system operating with DG's. Over 50% reduction in loss profile is achieved for the results obtained by algorithm. Event with the different loading conditions reduction in loss profile of

the system is consistent. Under base load condition, system shows active losses 0.123 PU whether the system operating with DG connected at optimal location proposed by algorithm shows losses 0.057PU. Reduction in losses of the system achieved is 53.66%. This improvement is consistent at every incremental step as indexed in table. Fig. 5 graphically represents the results of table II. Fig shows the bar graph of loss profile improvement for all the cases.

TABLE II
PERFORMANCE EVELUVATION OF DG OVER ATIVE LOSS PROFILE OF THE SYSTEM

Loading condition	System status	Optimal Bus Location	Respective DG ratings (PU)	Active Power Loss (P_L)	P_L Profile Improvement (%)
100%	Without DG	-	-	0.123	53.66
	With DG	3,17,28	0.8256, 0.2134, 0.4571	0.057	
105%	Without DG	-	-	0.132	54.54
	With DG	3,17,28	0.8256, 0.2134, 0.4571	0.060	
110%	Without DG	-	-	0.142	55.63
	With DG	3,17,28	0.8256, 0.2134, 0.4571	0.063	
115%	Without DG	-	-	0.152	55.92
	With DG	3,17,28	0.8256, 0.2134, 0.4571	0.067	
120%	Without DG	-	-	0.163	56.44
	With DG	3,17,28	0.8256, 0.2134, 0.4571	0.071	

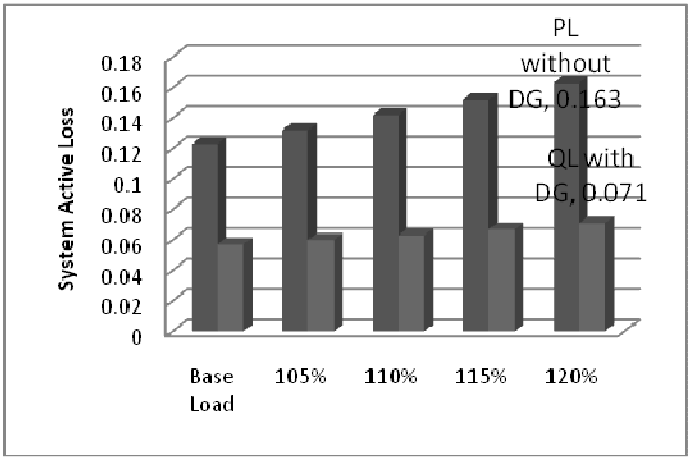

Fig. 5. Active loss profile of the system: Comparative analysis between without DG and with DG condition of the system

Improvement in reactive loss profile of the system is presented in table III showing improvement over 50%. Results are verified for different loading conditions. Improvement in loss profile is consistent for each case. Reactive loss profiles of system without DG's and with DG's comparatively graphed in fig. 5. Graph presenting the consistency of the results.

With the entire objective variables algorithm showing improved results which are consistent even with increased load. This algorithm successfully satisfies all the constraints and providing the location and sizing of DG's which are most optimal for DG location.

TABLE III
PERFORMANCE EVELUVATION OF DG OVER RECTIVE LOSS PROFILE OF THE SYSTEM

Loading condition	System status	Optimal Bus Location	Respective DG ratings (PU)	Reactive Power Loss (Q_L)	Q_L Profile Improvement (%)
100%	Without DG	-	-	0.088	51.13
	With DG	3,17,28	0.8256, 0.2134, 0.4571	0.043	
105%	Without DG	-	-	0.094	52.12
	With DG	3,17,28	0.8256, 0.2134, 0.4571	0.045	
110%	Without DG	-	-	0.101	52.47
	With DG	3,17,28	0.8256, 0.2134, 0.4571	0.048	
115%	Without DG	-	-	0.109	53.21
	With DG	3,17,28	0.8256, 0.2134, 0.4571	0.051	
120%	Without DG	-	-	0.116	53.54
	With DG	3,17,28	0.8256, 0.2134, 0.4571	0.054	

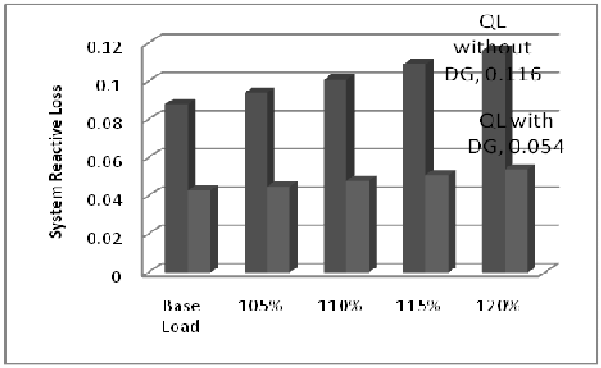

Fig.5. Reactive loss profile of the system: Comparative analysis between without DG and with DG condition of the system

Conclusion

DG's installation in distribution networks have attained a significant importance in the power system during last decade. This is because of the fact that the cost of such generation is sharply decreasing due to continuous advancement in renewable generation technology and demand of electricity is going on increasing day by day. Hence researches trying hard to exploit non-conventional energy to meet the future energy demand. Different classical, conventional, heuristic and meta-heuristic approaches have been proposed by scientists for the optimal placement & sizing of DG in the distribution network in order to maximize the benefits of DGs.

This paper presents a heuristic approach (Genetic Algorithm) to carry out optimal placement of DG in distribution network.

The analysis is executed on the IEEE 33-bus radial distribution network, and the results show the remedial effect of DGs, in voltage profile improvement and loss reduction of the system. Analysis of the results performed by load flow analysis depicts the effectiveness of the approach. Voltage profile and loss profile the system have attained considerable improvement for the proposed optimal location and sizing by the algorithm. These results have tested in different system loading conditions and overall analysis shows that the results are even consistent over wide range of load variation. This proves the effectiveness of the optimization technique.

GA search space is completely random which is extended up to the limits of distribution system, this enhances the effectiveness of the algorithm. DG location and size in distribution system was bounded by some inequality constraints and this algorithm successfully attends the convergence with satisfying all the constraints.

GA is advantageous as it have less computation time and posses high level of convergence. Search space of this technique is random and works on principal of genetic evolution which provides solution near to global optima.

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A Packet Loss Recovery Mechanism for the Packet Loss in Adaptable Network-on-Chips

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Abstract: Network on Chip a bettering system of System on Chip replacing the traditional bus architectures with Switches and Routers is considered for dynamic reconfiguration. Dynamic reconfiguration of Network on Chip limits the usage of unwanted hardware resources and making the system to work well in varying operating conditions. Though the dynamic reconfiguration reduces the usage of hardware resources and work well in varying operating conditions, there is an increase in packet loss of the system due to processing core's modification by reconfiguration. There have been ideas proposed to dimension the buffer size for reducing packet loss, meanwhile the throughput and latency gets affected when buffer size is changed. So a retransmission protocol for recovering the lost packets in the reconfigurable Network on Chip is proposed here to reduce the packet loss without affecting throughput, and giving better latency measurements compared to other adaptive Network on Chip.

Keywords: Fault injection, Automatic repeat request-selective repeat, processing cores, packet transmission efficiency

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Introduction

Network on Chip (NoC) is a new paradigm of incorporating a communication subsystem between Intellectual Property Cores(IP Cores) and System on Chip (SoC). Though, the NoC provides better performance, on considering the changing operating conditions and necessity to reduce workload, a dynamic reconfiguration (Adaptive) for FPGA design is adapted [1]. The Dynamic reconfiguration of NoC increases the flexibility, scalability and modularity of the system [2].

The problem of fixed locations of interconnection ports is the consequence of large number of switches. The Dynamic reconfiguration includes the idea of exchanging processing cores dynamically, adding or removing switches and links[3]. The dynamic reconfiguration can be applied to NoC on using a special routing table which must adapt the hardware modules as well as switches. This kind of Dynamic reconfiguration also involves the Processing core's reconfiguration [2].

When the reconfiguration takes place, the processing cores may process data or the network interface buffers, switch Buffers might have holding the data packet. In

those instances, the packets that are stored in the reconfigured modules (flit) are lost. The idea of dimensioning the buffer size for controlling the packet loss have been proposed already, but reducing the buffer size decreases the throughput and increasing the buffer size would consequently increase the latency [3]. So the error control mechanism –Automatic repeat request (ARQ)-Selective repeat is proposed here for recovering the lost packets. The proposed error control mechanism would test the reconfigurable NoC by injecting fault on the basis of Node's internal buffer size (uniform) and then controls the packet loss without dimensioning buffer size. Since the rate of packet loss is directly proportional to buffer size, fault injection rate is increased when Node's internal buffer size is increased. The error control mechanism assures us the maximum efficiency with better performance measurements of throughput as good as a Conventional NoC.

1. Fault injection

A technique of introducing faults to test code paths, which when executed may cause an error. In this work, the Fault injection technique is performed in-order to simulate a dynamic NoC from a Conventional NoC.

2. Automatic repeat request-Selective repeat

Automatic repeat request-Selective repeat is an error control mechanism used to recover the lost packets over a network by saving Acknowledgement(ACK) from receiver and resending lost packets. Here till the sender window size gets emptied, packet transmission occurs from sender to receiver. After that, lost packets are identified by inspecting already saved ACKs and are resent.

3. Processing cores

A Processing core(PU Core) is a unit that performs the operations of reading data from memory or sending data to the output device. Simply, it executes the program instruction from its memory.

4. Packet transmission efficiency

The ratio of number of packets received to number of packets sent is the packet transmission efficiency.

5. Effect of Dynamic reconfiguration on Packet loss

Conventional NoC is adapted to behave as a reconfigurable NoC with the DynaCORE simulation model. Figure 1 depicts the DynaCORE simulation model for Adaptive NoC [4]. In the Dynamic partition of DynaCORE simulation model reconfiguration takes place with six Hardware Assistance (HA).

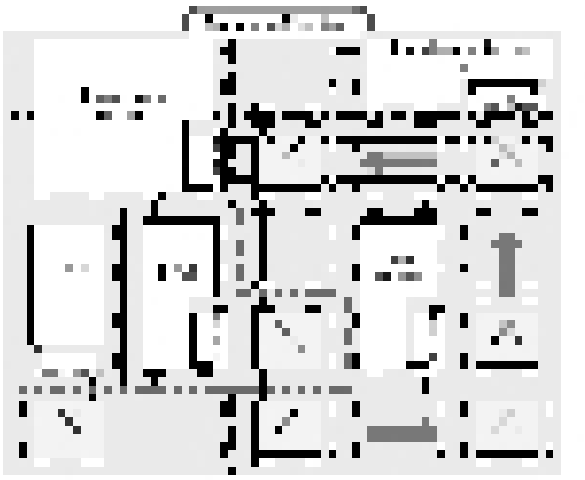

Figure 1. DynaCORE simulation model-Adaptive NoC

Hardware assistance acts as the payload module and it sends, receives packets through switches. Figure 2 specifies the dynamic modeling of NoC with reduced workload by removing unwanted resources.

In the dynamic partition of reduced workload NoC, when the system performs payload operations with HA3 or HA4, HA5 becomes unwanted resource. So, the Hardware module HA5 is replaced by lower power HA7 and HA8. The instructions or data that needs to reach the destination using Hardware modules HA5 now passes through Hardware modules HA7 or HA8.

Since power requirement is low to pass through HA7 or HA8, the energy spent by the process at this instance is less compared to the energy spent for HA5. This results in reduction of workload in NoC. Switches and links workload is also reduced as the buffer rate needed is limited for HA7, HA8 [5].

Though, the workload is reduced, loss of packet occurs, when reconfiguration takes place. The PU cores, that performs an instruction using an hardware module, may lose its support from that module, if it is replaced by some other

Module at reconfiguration. Ultimately, the packets that are involved with this process is lost. On dimensioning buffer size, lost packets can be recovered. But, change in buffer size affects throughput and latency in either way [3].

The error control mechanism ARQ-Selective repeat is proposed here for recovering lost packets without degrading throughput .It also assures a minimum latency when compared to other adaptive NoC.

In the Figure 2 as depicted, the workload due to HA5 for the total system is reduced when NoC uses HA7, HA8 to replace HA5. But due to this reconfiguration, PU cores that needs to process the data with HA5 leads to packet loss.

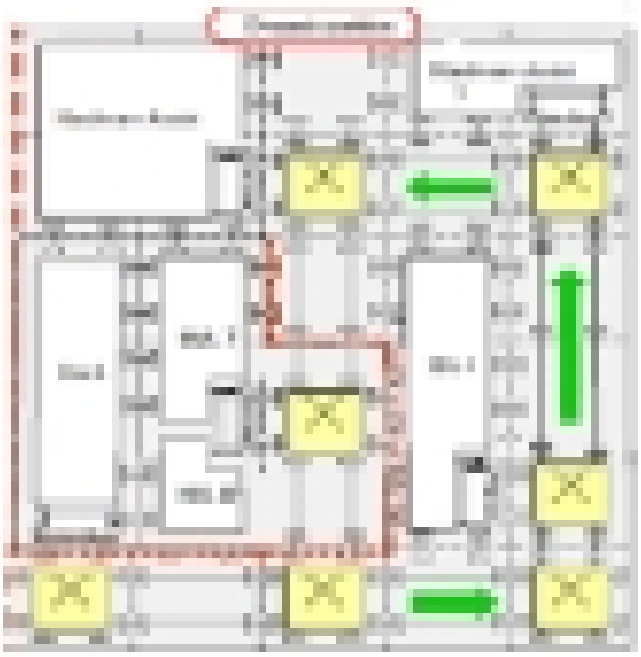

Figure 2 .Replacement of Hardware module HA5 by HA7, HA8 in DynaCORE simulation model

6. Analysis of NoC topologies to inject fault

In-order to obtain the best performance with packet loss recovery model from the reconfigurable NoC, efficient topology must be incorporated into it .To find the efficient topology for the fault injection and to implement the error control mechanism, various analysis is made with Topologies-Mesh, Torus, Fat tree, Extended Fat tree of Conventional NoC [6]. Though, throughput rate is similar in all topologies, the latency is quiet low in Extended Fat tree. Figure 3 specifies the comparison study of all topologies and shows that Extended Fat tree has lower latency, less hop count and compared to other topologies. Figure 4 gives the statistical graphical data of Conventional NoC Topologies.

A topology is said to be efficient if it possess high throughput and low latency and in the On Chip Network system Extended Fat tree proves to be efficient. On incorporating the best topology for the fault injection, better results would be obtained after the error control mechanism is implemented into it. Hence, the Extended Fat tree is considered for fault injection purpose.

Figure 3 .Analysis of Topologies based on Conventional NoC

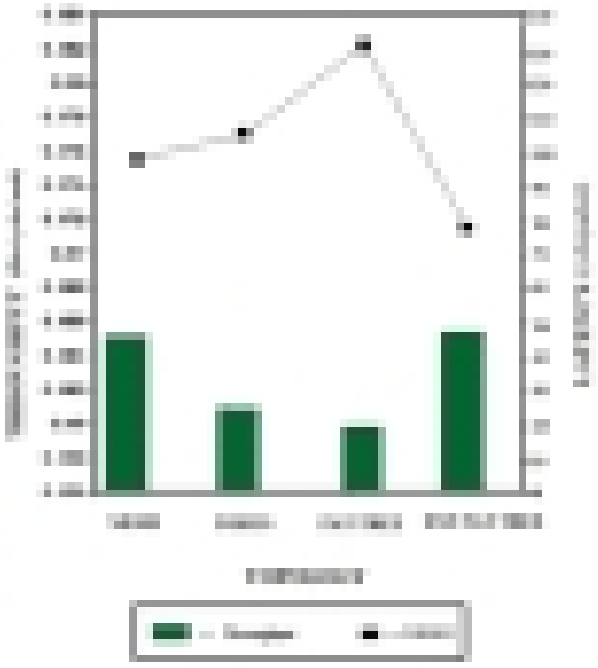

Figure 4 .Statistical graph data for the analysis of topology

7. Fault injection to simulate an Adaptive NoC

The Conventional NoC differs from dynamic NoC at the packet loss rate. In-order to implement an error control mechanism in the dynamic NoC, Simulation of dynamic NoC is done first. Simulation of dynamic NoC needs packet loss considerations. To do so, fault injection is performed in the system. Extended Fat tree NoC is considered for the fault injection.

In a dynamic reconfigurable NoC, when the size of buffer increases the packet loss also increases. Reconfigurable NoC system with the Node's buffer size ranging from 4 packets to 128 packets is simulated with fault injection at the flit addition part of node's buffer. It results in packet loss and this loss rate gets varied for varying buffer size. Figure 5 shows fault injection at the flit addition part.

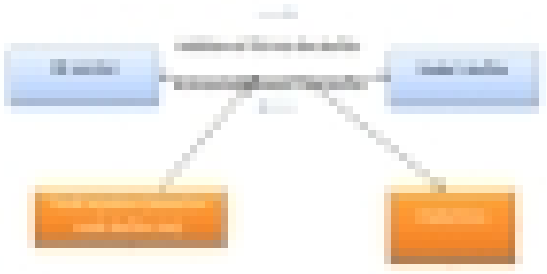

Figure 5. Fault injection at the Node's Internal buffer

8. Error control Mechanism to recover Lost packets

ARQ-Selective repeat protocol is implemented to recover the lost packets. To recover the packets, flit counters are devised at the sender's and node's buffer. For each cycle that is executed, the set of flits to be sent is saved in flit counter of sender. At the end of cycle, the sender on checking its counter and comparing with buffer's counter finds if any of the flit is missing, and retransmits the lost packets. Here, the sender tries to resend data to the buffer up to 3 cycles from the current cycle. Retransmission will take place once per cycle and the sender stops resending the packet if it gets ACK from the buffer for the resent packet.

With the proposed error control mechanism in reconfigurable NoC, output unit is assured with the minimum packet loss and maximum throughput and it is as equal as the Conventional NoC delivers. Figure 6 shows the system design for error control mechanism followed to recover the lost packet in Dynamic NoC.

The reason behind resending the data in the succeeding cycle is that the PU cores that requests for a functional unit in the processing system to process an instruction or flit would be busy processing the successive flits of the same cycle which also requires the same functional unit as the lost flit requires. So, after a particular time, the functional unit that is required for processing lost flit gets freed and PU cores would be able to process the lost flit. A threshold of 3 cycles is kept for resending the data, as exceeding this 3 cycles from current cycle results in a poor performance of latency. This mechanism would recover most of the packets at a reduced latency compared to other reconfigurable NoCs .

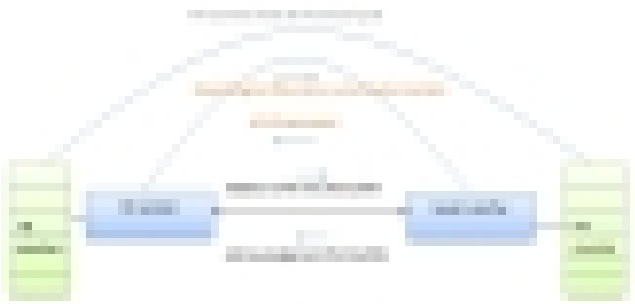

Figure 6 . Error control mechanism for Packet loss in a Dynamic NoC

9. Simulation Results

The rate of packet loss varies when Node's internal buffer size changes. On the basis of packet loss observed in Adaptive NoC, fault injection is performed. The error control mechanism adapted to recover the lost packets, works well and it gets back the lost packet without modifying buffer size. This causes the throughput not getting affected and latency is little higher compared to Conventional NoC. Figure 7 shows the Extended Fat tree efficiency when dynamically reconfigured. Figure 8 shows the Extended Fat tree performance of throughput and latency when dynamically reconfigured. packet transmission efficiency without error control shows the packet loss rate that occurs in an adaptive NoC, and the packet transmission efficiency with error control gives the performance measurement after the error control mechanism is implemented. Figure 9 shows the statistical results of fault injected and error controlled performance of the Adaptive NoC.

As the buffer size increases, packet loss also increases. When buffer size is 4, packet loss is less than 3 percent. When the buffer size is increased to 128 packets packet loss increases to 30 percent [3]. When the error control mechanism is implemented, irrespective of the buffer size, the efficiency gets increased as it recovers almost all the packets that are sent. Around 99 percent of efficiency is incurred when ARQ-selective repeat mechanism is implemented. The average packet delay increases when the buffer size increases. The delay that takes place here is little higher compared to Conventional NoC.

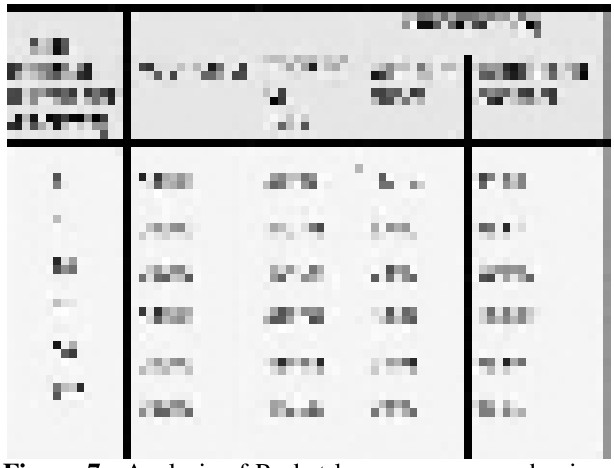

Figure 7 . Analysis of Packet loss recovery mechanism for efficiency on Extended Fat Tree topology with varying Buffer size.

The comparison study of Conventional NoC and Adaptive NoC is shown in Figure 10.It is evident that the efficiency and throughput is as good as the Conventional NoC [6]. Little variation occurs in latency as the lost packets are recovered in the succeeding cycles. There has been an increase in packet injection rate of Adaptive NoC compared to Conventional NoC. Hop count gets reduced in adaptive NoC, whereas the run time gets increased.

Figure8.Analysis of Packet loss recovery mechanism for Runtime,throughput,latency on Extended Fat Tree topology with varying Buffer size

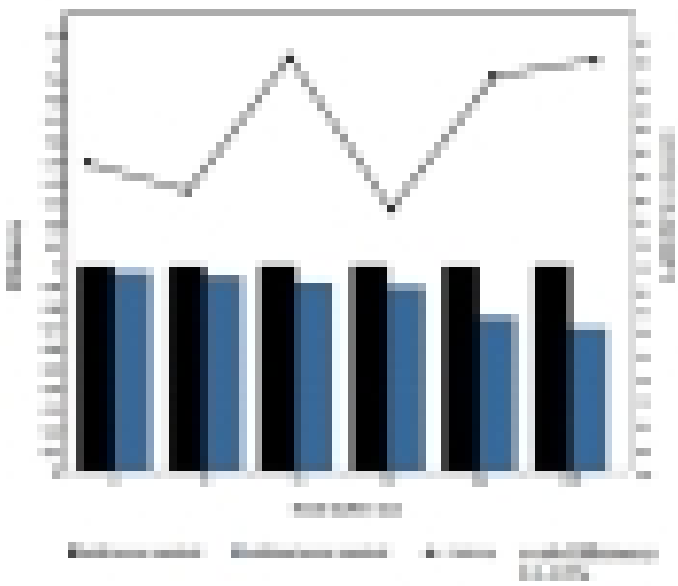

Figure 9 .Statistical graph data for the Adaptive NOC without error controlled and with error controlled.

Figure 10 . Conventional NoC versus Adaptive NoC

10. Conclusion and future work

The reconfigurable NoC system suffers from packet losses and recovery mechanisms on varying buffer size is proposed already. But dimensioning buffer size causes increase in latency and decrease in throughput. With the proposed contrive, the dynamically reconfigured NoC is recovered from packet loss without

changing buffer size. As a result, there is an increase in efficiency and throughput for the Adaptive NoC and is as good as a Conventional NoC. The packet loss is reduced to less than a percent, for any range of node's internal buffer size. But, there is performance degradation in latency and the delay occurring in the error controlled Adaptive NoC is higher than a Conventional NoC's delay. As, the efficiency and throughput is concerned, the proposed mechanism retransmits the packet thrice, but it causes the latency to increase. In future, efforts will be given to reduce latency and make the adaptive NoC as good as Conventional NoC in all the parameters.

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Solar Cell: Emerging technologies

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Abstract:
Solar power technologies will have to become a major pillar in the world's future energy system to combat climate change and resource depletion. However, it is unclear which solar technology is and will prove most viable. This paper gives an up to date perspective of PV technology and materials. The most important material has been and still is silicon. Crystalline silicon solar cells are still heavily dependent on the materials base of the semiconductor industry. Great hope rests with the thin film materials which require only small amounts of material. A great number of new concepts and materials are still in the research stage. Importantly, the competitiveness of the different technologies varies considerably across locations due to differences in, e.g., solar resource and discount rates.

Key words : Crystalline silicon solar cell, Thin film solar cell, dye sensitized cell.

Introduction

Society is facing serious problems such as climate change, resource depletion, and pollution. To meet these challenges a ''technology revolution'' (Galiana and Green, 2009) in the field of clean energy technologies is required in order to decouple economic growth from adverse environmental impacts. Solar power has the potential to become a protagonist in this ''revolution''. During the nineties decade, many electric utilities throughout the world have forced to change their way of operation and business, from vertically integrated mechanism to open market system. The increase in energy consumption, particularly in the past several decades,has raised fears of exhausting the globes reserves of petroleum and other resources in the future. The huge consumption of fossil fuels has caused visible damage to the environment in various forms.Every year human activity dumps roughly 8 billion metric tones of carbon into the atmosphere, 6.5 billion tonnes from fossil fuels and 1.5 billion from deforestation [2].

Which technology is and will prove most viable in our electricity systems is heavily contested among scholars and industry experts while the competitiveness of solar power generation differs by technology, time and location the extant literature lacks a holistic assessment of solar power based on these three dimensions. Integrating existing studies into one overall picture is not possible since they rely on a variety

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of methods and mostly inconsistent assumptions. Hence, there is a clear need to holistically and accurately assess key solar technologies on a common basis to guide users, investors, technology providers and policymakers in terms of investment and policy funding. In this paper we concentrate on recommendations for future policymaking as policy is likely to be the single most important lever to lead solar power towards competitiveness.

An Overview of Emerging Solar Technologies:

(a) Si Wafer based Solar Cell Technology

The first serious solar cell development started early in 1940s when a P-N junction was obtained by growing N-type Si from melt on P-type Si. In this case the junction was non uniform and resulted cell efficiency much lower than 1%. In the 1950s, implementation of helium on P-type polycrystalline Si, which provided flat junction, resulted in about 1% efficiency. The improvement in solar cell efficiency due to technological progress made over the years can be divided into three categories:

- Improvement in efficiency due to enhanced light absorption or increased carrier generation.
- Improvement in efficiency due to reduction in carrier recombination.
- Improvement in efficiency due to reduction in the resistive losses.

There are two types of wafer based solar technology:

1. Mono Crystalline PV Cells : made up of sections of a single silicon crystal. When cooling, the molten silicon solidifies into a single large crystal. Afterwards, the glass is cut into thin layers that give place to cells. The overall aspect is uniform blue. As for features, it has a good performance, between 14 and 16%, and a good area uptake ratio (Wp/m2), about 150 Wp/m2 , which saves space if necessary. In addition, it exists a large number of producers even though the cost continues being high.

2. Multi Crystalline PV Cells : These are formed by crystallized small particles. During the cooling of the molten silicon, it solidifies creating many crystals. Their appearance is blue too, but it is not uniform, since we can distinguish several different colors created by the glass. As for their characteristics, they have a better performance than the monocrystalline within a module, due to the fact they are square cells, unlike the monocrystalline cells that have rounded edges. Its conversion efficiency is still slightly lower, although still good, and the cost of production is cheaper. The problem with the low performance is shown in low light conditions.

(b) Thin Film Solar Cell Technology

The primary objective of development of thin film technologies is to reduce the cost of PV modules significantly lower than the cost of PV modules obtained from

wafer-based solar PV modules. There are lots of advantages of thin film PV over Crystalline modules but has significant lower efficiency compared to crystalline PV module. There are three types of thin film Solar PV module, as follows:

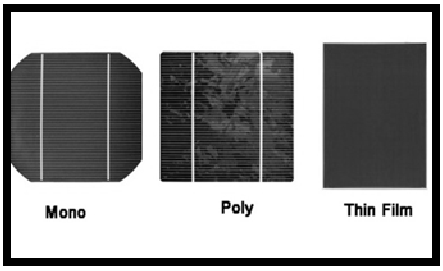

Fig. 1 Types of Solar cell technologies

1. Amorphous Si Solar Cell Technology : These cells are produced when the silicon has not yet crystallized during processing, and it produces a gas that is projected onto a glass slide. Its appearance is dark gray and they were the first to be manufactured. These can be seen in calculators, watches, etc. They are able to operate with low diffuse light, even on cloudy days. The cost is much smaller and it can accommodate both flexible and rigid media. Against this, the performance, in full sunlight conditions, is between 5 and 7%, and it decreases, with the pass of time, around 7%.

2. Cadmium Telluride Solar Cell Technology : The first solar cell based on CdTe/CdS has been reported in 1972 with an efficiency of 6%. Since then, significant improvement has been made in the cell and the highest efficiency of 16.5% has been reported.

3. Chalcopyrite (CIGS) Solar Cell Technology : This technology has potential for high efficiency and stable efficiency. The most important chalcopyrite compounds for solar cell applications are $CuInSe_2$, $CuInS_2$ and $CuGaSe_2$ with the band gap of 1 eV, 1.5 eV and 1.7 eV, respectively. The chalcopyrites have very high optical absorption; therefore only thin layer of material is required. Solar cell efficiency close to 20% has been realized.

(c) Dye-sensitized cells:

Nano-crystalline dye-sensitized solar cells are based on the mechanism of a fast regenerative photo electrochemical process [5]. The main difference of this types of solar cells compared to conventional cells are that the functional element, which is responsible for light absorption (the dye), is separated from the charge carrier transport itself. The major advantage of the concept of dye sensitization is the fact that the conduction mechanism is based on a majority carrier transport as opposed to the minority carrier transport of conventional inorganic cells.

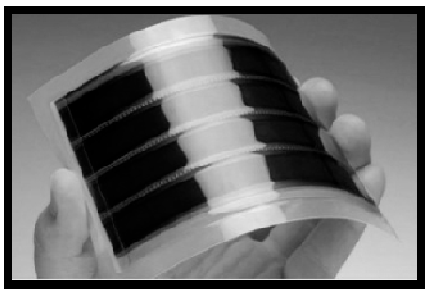

Fig.2 Dye sensitized solar cell

(d) Organic solar cells:

Besides dye-sensitized solar cells which may be considered as organic/inorganic hybrid cells, other types of organic solar cells have currently become of broader interest. Extremely high optical absorption coefficients are possible with these materials, which offer the possibility for the production of very thin solar cells (far below 1mm) and therefore only very small amounts of needed materials. Before these cells become practical, which at the moment looks still far away, the efficiency will have to be increased further. Also, long-term stability and protection against environmental influences are significant challenges.

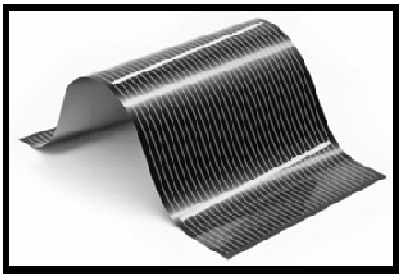

Fig. 3 Organic Solar cell

Future of Solar Energy:

India, faced with twin challenges on energy and environmental front, has no option but to work towards increasing the role of renewable in the future energy systems. The objective of the JNNSM is to establish India as a global leader in Solar Energy.

- To create an enabling policy framework for the deployment of 20,000 MW of solar power by 2022.
- To create favorable conditions for solar manufacturing capability, particularly solar thermal for indigenous production and market leadership.
- To promote programs for off grid applications, reaching 1000 MW by 2017 and 2000 MW by 2022.
- To achieve 15 million m^2 solar thermal collector area by 2017 and 20 million by 2022.

- To deploy 20 million solar lighting systems for rural areas by 2022.
- JNNSM Mission has set a target of 1000 MW by 2017, reaching million households. To meet this target, the Mission plans to provide solar lighting systems to over 10,000 villages and hamlets and also to set up stand alone rural solar power plants in special category States and areas such as Lakshadweep, Andaman & Nicobar Islands and the Ladakh region of Jammu & Kashmir.

Research and Development Investment

A number of major government and industry R&D efforts aim to make STE and CPV a mainstream power source within the next decade. India is each pursuing an aggressive solar energy growth strategy, creating a very important industry and setting up ambitious mid-term targets for the domestic market in the multi-GW scale. The total expected funding from the government for the 30-year period will run to Rs. 85,000 crore to 105,000 crore [7].

Conclusion

India has a severe electricity shortage. It needs massive additions in capacity to meet the demand of its rapidly growing economy. Solar energy development in India can also be an important tool for spurring regional economic development, particularly for many underdeveloped states, which have the greatest potential for developing solar power systems which is unlimited and clean source of energy. It can provide secure electricity supply to foster domestic industrial development. So it can be concluded that photovoltaic power systems will have an important share in the electricity of the future not only in India, but all over world.

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Review paper on Piezoelectric Transducer and its Applications

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Abstract: A piezoelectric crystal used as a transducer, either to convert mechanical or acoustical signals to electric signals as in a microphone or vice versa. Piezoelectric materials are the main functional materials for sensors and actuators in smart structures. It used in the measurement of strain, vibration and deformation; they also find application in apparatus for weighing and for sorting according to weight. Transducer is that a force, when applied on the quartz crystal, produces electric charges on the crystal surface. The charge thus produced can be called as piezoelectricity. Piezoelectricity (also called the piezoelectric effect) is the appearance of an electrical potential (a voltage, in other words) across the sides of a crystal when you subject it to mechanical stress. In this paper we are introduced piezoelectric transducer application, merits and demerits and compare the piezoelectric transducer, RTD, thermocouple and thermostat etc.

Key words: Piezoelectric Transducer, Lead Zirconate Titanate (PZT)

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Introduction

Piezoelectricity is the ability of some materials (notably crystals and certain ceramics) to generate an electrical potential in response to applied mechanical stress. The piezoelectric effect was discovered in 1880 by two French physicists, brothers Pierre and Paul-Jacques Curie, in crystals of quartz, tourmaline, and Rochelle salt (potassium sodium tartrate). They took the name from the Greek work “piezein”, which means "to press."This may take the form of a separation of Electric charge across the crystal lattice. If the material is not short circuited, the applied charge induces a voltage across the material. A transducer converts one form of energy into another. In the case of a piezoelectric transducer the transduction is from, mechanical energy to electrical energy. The prefix “piezo” is a Greek word meaning “to squeeze”. Materials that produce an electric charge when a force is applied to them exhibit what is known as the piezoelectric effect. Many piezoelectric materials are known to exist. Quartz, tourmaline, ceramic (PZT), GAPO4 and many others. The active element in all piezoelectric devices is a piece of piezoelectric mat. The common types (modes) of piezoelectric sensors in use today are: ¶ Voltage mode-(IEPE, LIVM, ICP, Piezotron, Isotonic) ¶ Charge mode¶ Each of these designs have their advantages and Disadvantages. Or we can

say that the certain single crystal materials exhibit the following phenomenon: when the crystal is mechanically strained, or when the crystal is deformed by the application of an external stress, electric charges appear on certain of the crystal surfaces; and when the direction of the strain reverses, the polarity of the electric charge is reversed. This is called the direct piezoelectric effect, and the crystals that exhibit it are classed as piezoelectric crystals. Piezoelectricity has been demonstrated qualitatively in approximately 1000 crystal materials. These include materials where piezoelectricity occurs naturally, and other single crystal and polycrystalline materials in which piezoelectricity can be induced by the application of High voltage or poling. If the frequency of the AC field corresponds with the frequency where the thickness of the crystal represents half a wavelength, the amplitude of the crystal vibration will be much greater. This is called the crystal's fundamental resonance frequency. One way to measure the efficiency of a transducer is to compare the amount of input energy versus output energy. Anytime energy conversion occurs, some amount of energy will be lost during the process. In general, the greater the amount of output energy produced in relation to input energy, the greater the level of efficiency that is present. Piezoelectric crystals have: Produce electric field when subject to an external force Expand or contract in response to externally applied voltage.

Review Process Adopted

A literature review is necessary to know about the research area and what problem in that area has been solved and need to be solved in future. This review process approach was divided into five stages in order to make the process simple and adaptable.

The stages were:-

Stage 0: Get a “feel”

This stage provides the details to be checked while starting literature survey with a broader domain and classifying them according to requirements.

Stage 1: Get the “big picture”

The groups of research papers are prepared according to common issues & application sub areas. It is necessary to find out the answers to certain questions by reading he Title, Abstract, introduction, conclusion and section and subsection headings.

Stage 2: Get the “details”

Stage 2 deal switch going in depth of each research paper and understand the details of methodology used to justify the problem, justification to significance &novelty of the solution approach, precise question addressed, major contribution, scope & limitations of the work presented.

Stage 3: “Evaluate the details”

This stage evaluates the details in relation to significance of the problem, Novelty of the problem, significance of the solution, novelty in approach, validity of claims etc.

Stage 3+: “Synthesize the detail”

Stage 3+ deals with evaluation of the details presented and generalization to some extent. This stage deals with synthesis of the data, concept & the results presented by the authors.

Various Issues in the Area

After reviewing 10 research papers on piezoelectric transducer and its application we have found following issues, which has to be addressed, while the designing and implementation of the piezoelectric transducer issues are:

a. Mechanical stress limitations
b. Displacement Amplitude and Output Power
c. Vibration modes
d. Temperature range required

Issue Wise Discussion

Issue1:- Mechanical stress limitations

High mechanical stress can cause permanent loss of the piezoelectric property in a device. Although mechanical force is not directly loaded on the device in power circuit applications, mechanical stress should still be considered. The limit on the applied stress is dependent on the type of ceramic material, and duration of the applied stress. This device is electromechanically coupled such that mechanical factors are analogous to electrical ones. For example, the mechanical stress appears as current stress in electrical domain. Therefore, it is indispensable to fully understand the relationship between the material characteristics and circuit parameters in designing a piezoelectric device for a target power application.

Issue 2:- Displacement Amplitude and Output Power

In many instances, it is desirable to know the displacement amplitude and power output of a transducer. Theoretical expressions can be derived for these quantities but they are usually complicated functions involving a number of parameters. Theoretically, piezoelectric plates can be excited to any amplitude of vibration at any frequency, however far from resonance, if the applied voltage is sufficiently high. In practice, however, the maximum power output which can be achieved without damaging the crystal depends on several variables including the type of mounting, frequency, medium, inertia, elastic compliance and internal damping losses of the vibrating crystal itself. These internal losses are a function of the driving frequency. When the operating frequency approaches a resonance, the internal losses sharply decrease and accordingly the amplitude of deformation increases. For high fields, the crystal can suffer dielectric breakdown and mechanical fracture. The sensor manufacturer usually sets the bias voltage halfway between the lower and upper cut-off voltages (typically 2V above ground and 2V below the minimum supply voltage). The difference between the bias and cutoff voltages determines the voltage swing available at the output of the sensor. The output voltage swing determines the peak vibration amplitude range.

Issue 3:- Vibration modes (shape design)

Longitudinal and radial vibration modes are advantageous to achieve wide bandwidth because k33, electromechanical coupling coefficient of longitudinal

mode transducer and kp, that of radial mode transducer are large in case of PZT materials. Radial vibration mode is suitable for a low- voltage and high-current system because of its low mechanical loss factor, and longitudinal vibration mode is vice versa. Therefore, in this paper, the radial mode is selected to obtain a low equivalent resistance for high efficiency. A piezoelectric device has maximum vibration velocity limit. If the vibration velocity exceeds the critical point, the piezoelectric device performance dramatically decreases with heat generation.

Issue 4:- Temperature range required

Generally, as temperature increases, piezoelectric energy transfer performance decreases. As the material's Curie point, device loses its piezoelectric properties from permanent depolarization. Each material has its own Curie point, about 150-400 degree Celsius and it is recommended that the operational temperature be kept below half of the material's Curie temperature. The Curie point of hard-type materials used in power application is around 300 degree Celsius, which is relatively higher than soft-type materials .The Curie point is the absolute maximum exposure temperature for any piezoelectric ceramic. Each ceramic has its own Curie point. Because conventional power circuits normally operate under less than 150 degree Celsius, it is relatively easy to keep the temperature in a suitable range for the piezoelectric device. When the ceramic element is heated above the Curie point, all piezoelectric properties are lost. In practice, the operating temperature must be substantially below the Curie point.

V. Issue Wise Solution Approaches Used

The solution approaches under the various issues have been shown in the table, which includes additional information like hardware, software, variable/parameters used along with results obtained. The same table also describes the Comparative analysis between various solution approaches.

Issue Wise Discussion on Results

Issue 1:- Mechanical stress limitations

1. Piezoelectric property Increased by mechanical operation tripping over the cable/design
2. Ceramic material It should be high consideration
3. Strength of the penetrative Material quantity interconnection increase

Issue 2:- Displacement Amplitude and Output Power

1. Ultrasonic frequencies To reduced them, then improves the Amplitude
2. Frequency range 350-550 kHz
3. Source and receiver order Same

Issue 3:- Vibration modes

1. Best material of ceramics Quartz resonators are used to improve vibration modes
2. Characteristics Longitudinal and radial are used to achieve wide bandwidth
3. Radial vibration mode Suitable for low voltage and high current application and reduce low mechanical loss factor
4. Impedance characteristic Low because high efficiency

Issue 4:- Temperature range required

1. Curie point of material Around 300(degree C)
2. At low impedance Moderate characteristic
3. Improvement property of Moderate piezoelectric transducer

Conclusion

The reviewed of 10 research papers has been carried out in the area of piezoelectric transducer and find out current challenges and scope of work. After the reviewed, we were found many issues like that Frequency level and vibration modes for new technologies, New trends in Mechanical stress limitation, Temperature range required & Vibration modes which should be given proper concern, when the enhancement of security takes place. The technology and trends are changing day by day in Electrical field, nowadays simulation software have made their own place. We can see the plant response be far before starting the plants. Time is also important; IEEE standard 1588 is a fast time based control algorithm to improve the system delays.

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Transmission Planning Approaches in Deregulated Power Sector

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Abstract
Transmission planning (TP) has faced a significant change since the deregulation of power systems. It becomes even more complicated due to the conflicting objectives and uncertainties which have been exposed by the power industry restructuring. In the new environment, generation planning is mainly a decision-making issue of generating companies or investors, and transmission planning is done separately in response to expected changes in the generation/load patterns. In deregulated power system (DPS) participants decide independently and they change their strategies frequently to acquire more information from the market to maximize their benefits. Consumers adjust their loads according to the price signals. Availability of IPPs is uncertain. Wheeling powers are time varying and affect the nodal prices of the control areas that they pass through. In addition, in a competitive environment planners do not have access to all required information for the planning. Since the methods of considering the random and non-random uncertainties in planning are different, power system uncertainties must be specified and classified clearly before planning. In this paper transmission expansion planning approaches are classified. Nondeterministic transmission planning approaches are categorized and summarized. Non- deterministic Transmission planning issue in deregulated power systems is discussed.

Keywords : Competitive electric market, Transmission expansion planning, Uncertainty, Probabilistic load flow, Probabilistic reliability criteria, Scenario techniques, Flexibility, Decision Analysis.

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Introduction

TP is an important part of power system planning. Its task is to determine an optimal network configuration according to load growth. The basic principle of TP is to minimize the network construction and operational cost satisfying the requirement of delivering electric power safely and reliably to load centres [3]. Generally speaking the TEP should answer the following questions:

i. Where to build a new transmission line?
ii. When to build it?
iii. What type of transmission line to build?

It is recognized that the allocation of transmission costs in a competitive environment will require more careful evaluation of alternative transmission expansion plans. In traditional power system planning, generation planning is the core while transmission planning is based on generation planning. In the new environment, generation planning is mainly a decision-making issue of generating companies or investors, and transmission planning is done separately in response to expected changes in the generation/load patterns. From the viewpoint of transmission planner, there are two major differences between planning in regulated and deregulated environments [2].

- Objectives of transmission expansion planning in deregulated power systems differ from those of the regulated ones.
- Uncertainties in deregulated power systems are much more than in regulated ones**.**

The main objective of TEP in regulated power systems is to meet the load demands as economically as possible, while maintaining power system reliability. In this environment uncertainty is low and planners have access to the required information for planning. TEP in regulated systems is modelled by a deterministic optimization. Many mathematical and heuristic approaches have been proposed for solving this problem [1]. Restructuring and deregulation of the power industry have changed the objective of TEP and increased the uncertainties.

Due to these changes, new approaches and criteria are needed for **TEP** in DPS. **TEP** approaches are classified in section II**.** Non- deterministic TEP approaches are categorized and summarized in section III. In section IV the issue of TEP in DPS is discussed.

Classification of the TEP Approaches

We can classify the TEP approaches from the following viewpoints [3].

1. Power system structure
   - 1.1. TEP approaches for regulated power systems
   - 1.2. TEP approaches for DPS
2. Power system uncertainty
   - 2. 1. Deterministic approaches
   - 2.2. Non-deterministic approaches
3. Power system horizon
   - 3.1. Static approaches
   - 3.2. Dynamic approaches

Both deterministic and non-deterministic approaches have been used for the planning of regulated and deregulated power systems.

Non-Deterministic Approaches

The limitation of deterministic approaches is that they consider only the worst cases of the system without considering the probability of occurrence or degree of importance of these cases. Non-deterministic methods consider many cases with

assigning a probability of occurrence or a degree of importance to each of them and hence are able to model the past experience, future expectations and uncertainties. The main non-deterministic approaches which have been used for TEP are [1-5]:

A. Scenario techniques
B. Decision analysis
C. Probabilistic load flow (PLF)
D. Probabilistic reliability criteria (PRC)
E. Fuzzy decision making

The uncertainties can be classified in two categories: random and non-random uncertainties. Approaches A and B are able to take into account random uncertainties, *C* and D non-random uncertainties, and E imprecision and vague data.

A. Scenario techniques

Scenario techniques and Decision analysis are more general and can he used for the planning of any system. The algorithm of expansion planning using scenario techniques is [10-12]:

Scenario techniques and Decision analysis are more general and can he used for the planning of any system. The algorithm of expansion planning using scenario techniques is **as** below:

- Determining a set of probable scenarios (futures).A scenario is a set of outcomes or realizations of all of the uncertainties. The scenarios must he defined so that to cover the uncertainties.
- Assigning a probability value or a degree of importance to each future (Wk).
- Determining the set of possible solutions (plans).
- Specifying a cost function to measure the goodness of each plan (suppose is the cost of plan *i* in scenario *k*).
- Using one of the following criteria to select the final plan:

1. Expected cost criterion (probabilistic choice): In probabilistic choice (PC) the plan that minimizes the expected cost is selected as the final plan.

2. Minimax regret criterion (Risk analysis): In risk analysis (RA) the best solution is determined by minimizing the regret**.** Regret is a measure of risk and is defined **as** the difference between the cost of selected solution and the cost of an optimal solution that would have been selected if planners knew beforehand which of the future scenarios would happen. If cost of the optimal solution for scenario ***k*** is the regret of solution ***i*** in future ***k*** is.

3. Laplace criterion: In this method the plan that minimizes the sum of costs over all scenarios is selected as the final plan.

4. Von Neumann-Morgenstern criterion: This is an extremely pessimist method and believes that the most unfavorable Scenario is hound to occur. According to this method the plan that minimizes the maximum cost over all Scenarios is selected as the final plan.

5. Hurwiez criterion: In this method the plan that minimizes a convex combination of the extremely pessimist solution and the extremely optimistic solution is selected as the final plan and then allows "altitude towards risk".

6. Pareto-optimal criterion: A plan is Pareto-optimum if plan **Y** if its cost is more than cost of plan **Y** in each scenario. This solution is not unique always.

7. Robustness criterion: a plan called robust in a scenario, if its regret is zero in this scenario. According to this criterion, a plan is acceptable if it is robust at least for ▮ % of scenarios**.**

8. ▪ -robustness criterion: according to this criterion a plan related optimal plan does not exceed ▮%. Planner can reduce the risk of TEP by developing hedges.

Hedging is a technique for reducing the risk by generating new alternatives**.** In fact hedges reduce the risk by reducing the number, or the probability of occurrence of Scenarios for which a plan is regrettable, or by reducing the regret of plans in adverse scenarios. Different type of hedges can be used for reducing the risk including: hedge in planning, insurance and finance, equipment, and system control. The process of considering hedge in TEP is described in the following steps**:**

- Measure the TEP risk. If there is a robust plan or the vulnerability is low, further effort is not needed.
- Measure exposure, i.e. identify the scenarios that the most robust plans are regrettable in these scenarios.
- Identify hedging options. Incorporate hedging options in transmission expansion plans and return to step I.
- The process continues until finding a low risk plan.

B. Decision Analysis

In Decision analysis planners try to find the most flexible plan. The flexibility is defined **as** the ability of adapting the system quickly and at reasonable cost to any change in the conditions which prevailed at the time it was planted In this method, the entire set of scenarios over the [4] different periods of planning horizon is described by an event tree .This tree has two types of nodes: decision nodes and event nodes. The event tree starts with a decision node. Decisions are taken at decision nodes. The branches that emanate from each decision node show the feasible decisions that can be taken at this node. Each of these branches is associated with the cost of correspondent decision and ended to an event node. The branches that emanate from each event node show the probable events that may occur and are associated with the probability of occurring. In fact a scenario is a complete path between the tree root and a final node. The procedure of finding the optimal decision over the entire planning period is a classical stochastic dynamic programming, starting from the end of decision tree, computing the expected cost beyond each event node, selecting the minimum one and continuing until the initial

node is reached. Decision analysis leads to the easiest adaptation to the future events.

C. Probabilistic Load Flow

PLF is similar to load flow except that it gets the probability density functions (pdf s) of loads as input and computes the pdf s of output variables using the Monte Carlo simulation. The pdf s of loads can be estimated based on the load prediction and uncertainty analysis**.** To reduce the computations, power flow equations are linearized around the expected value region and then convolution technique is used for computing the pdf s of outputs. The algorithm of TEP using PLF is as below [7-8]:

- Run the PLF for the existing network and given pdf s of loads for the planning horizon, and compute the reliability indices such **as** the probability of violating the line flow limits and voltage limits.
- Suggest some expansion plans based on the computed reliability indices.
- Add each of the suggested plans to the network separately, run the PLF, and compute the reliability indices. Select the hest plan based on the reliability indices and cost of each plan

D. Probabilistic Reliability Criteria (PRC):

The algorithm of TEP using PRC is as bellow**:**

- Suggest a number of transmission plans by analyzing the existing network [6].
- Add each of the suggested plans to the network separately, and compute the reliability criteria such as expected energy not supplied (EENS), expected number of load curtailment (ENLC), expected duration of load curtailments (EDLC), and so on, using Monte Carlo simulation.
- Select the final plan based on the reliability criteria and economic analysis.

E. Fuzzy Decision Making

Fuzzy logic was developed to model uncertainties, imprecision, and vague data. Therefore, it is a suitable tool for TEP in DPS. Fuzzy decision making approach can he summarized as bellow [9]:

- Representation of the decision problem
  - Identification of decision alternatives set
  - Identification of decision criteria set
- Fuzzy set evaluation of the decision alternatives
  - selection of preference ratings sets for importance weights of the decision criteria and for appropriateness degrees of the decision alternatives versus the decision criteria
  - Evaluation of the importance weights and appropriateness degrees
  - Aggregation of the importance weights and appropriateness degrees using fuzzy operators.
- Selection of the optimal alternative
  - Prioritization of the decision alternatives using the aggregated assessments.

- Selection of the decision alternative with highest priority as the optimal alternative

Tep in Deregulated Environments

The objectives of the transmission expansion planning have changed owing to restructuring of Power sector. Transmission systems in the deregulated environment have to provide non-discriminatory access to allow competition, robust transmission network against uncertainties etc. Uncertainties are handled by both deterministic and non-deterministic approaches. Non-deterministic methods consider many cases with assigning a probability of occurrence or a degree of importance to each of them and hence are able to model The Past Experience, future expectations and uncertainties.

The following are some of the main objectives of transmission planning in the deregulated environment [2]:

- Encouraging and facilitating competition among electric market participants.
- Providing nondiscriminatory access to cheap generation for all consumers.
- Providing a robust transmission network against uncertainties.
- Providing fair supply-side reserve for all generators and fair demand-side reserve for all consumers. Being value based instead of cost or reliability

Deregulation has increased the power system uncertainties. Consumers adjust their loads according to the price signals. Availability of IPPs is uncertain. Wheeling powers is time vary in grand affect the nodal prices of the control areas that they pass through. Transmission planning is not coordinated with generation expansion planning. Uncertainties can be classified in two categories: random and non random uncertainties .Random uncertainties are deviation of those parameters which are repeatable and have a known probability distribution. Hence, their statistics can [2] be derived from the past observations. Uncertainty in load is in this category. Non-random uncertainties are evolution of parameters which are not repeatable and hence their statistics cannot be derived from the past observations. Uncertainty in generation expansion is in this category. Since methods of modeling random and non-random uncertainties in planning are different, power system uncertainties must be identified and classified clearly before the planning process. In deregulated power systems, there is random uncertainty in: load; generation costs and consequently in bid of generators; power and bid independent power producer (IPPs); wheeling transactions; of availability of generators, lines, and other system facilities and non-random uncertainty in generation expansion/closures; load expansion/closures; installation/closure of other transmission facilities; replacement of transmission facilities; transmission expansion costs; market rules.

Because of these uncertainties, expansion of transmission system has been faced with great risks. Since risk assessment is characteristically based on probabilistic and stochastic methods, probabilistic methods should be developed for transmission planning in deregulated power systems.

A new method for transmission planning under deregulation is presented in [12]**.** This method tries to reinforce the transmission network so that all participants are

able to expand their loads and generations fairly. Two indices, supply-side reserve and demand-side reserve, are defined in this paper. Supply-side reserve of a bus is equal to the maximum power which can be injected to this bus without violating the network constraints minus its current injection power. Demand-side reserve of a bus is equal to the maximum load which can he tapped from this bus without violating the network constraints minus its current demand. This method uses linear programming based on DC power flow model to find the transmission plan that maximizes the supply-side reserve at IPP buses subject to equal normalized demand-side reserves at load buses. In this paper TEP are performed under two different assumptions: a) the locations of the IPPs are known in advance, and b) the locations of the lPPs are unknown. In the first case, transmission planning maximizes the supply-side reserves in the IPP buses while setting reserves to zero in the other buses. In the second case, supply- side reserves become uniform in all buses. Probabilistic power flow is used to consider the statistical characteristics of load changes and line fault occurrences [11]. A short-term transmission planning method is proposed in. Congestion cost index (CCI) assessment is used to promote fair competition. CCI is defined as the distance between the supply-demand equilibrium point and operation point. In this method first the contribution of each congested line in the average total CCI is computed. It is assumed that the average CCI for single line congestion is proportional to its contribution to the average total CCI resulting from the multiple line congestion. Contribution of a line in the average total CCI shows the frequency and severity of the line congestion. Installing new lines parallel with the lines that have noticeable contribution in average total CCI are suitable candidates for TEP. Each candidate is introduced to the network with the highest possible capacity and average total CCI is computed. The line that creates the minimum average total CCI is selected **as** final plan.

Conclusions

The characteristics of the DPS are completely different from those of the regulated power systems. Deregulation has increased the uncertainties drastically and therefore transmission planner has encountered a great risk. To take into account the risk of investment, probabilistic approaches should be developed for TEP. Identifying hedges and considering them in TEP are recommended for reducing the risks. On the other hand, Deregulation has changed the objectives of TEP. Providing a non-discriminatory environment for competing stack holders is the main objective of TEP in DPS. To achieve the new objectives, market based criteria should be defined for TEP. Competition, discrimination, social welfare and reliability must be considered in definition of new criteria.

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Power System with Artificial Neural Network

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Abstract :
This paper examines the benefit of artificial neural network, when applied to electric power system. Artificial neural network are applied to power system for many purposes and the results obtained shows that artificial neural network are fast, accurate and give promising results as compared to other methods / technologies applied to power systems. Artificial neural network found suitable for many applications like load forecasting, economic load dispatch problem, fault detection, restoration of power system, protection of power system, economic load dispatch etc.

Keywords : Protection, Load Forecasting, Fault Detection, Power System Restoration, Economic Load Dispatch.

Introduction

The demand of electricity is going on increasing from the beginning, Particular during last two three decades. There is sharp increment in load demand. So to meet this increasing demand, the use of artificial neural network (ANN) in power system have found very fruitful for operation and control. Due to interconnections of different grids, the power system become very large and hence probability of failure become large. Artificial Intelligence (AI) has been studied for many years with the hope of understanding and achieving human-like computational performance. The benefits include massive parallelism, architectural modularity, fast speed, high fault tolerance and adaptive capability. ANN applications to power systems can be categorized under three main areas: regression, classification and combinatorial optimization. Applications include transient stability analysis, load forecasting, static and dynamic stability analysis, economic dispatch etc. Artificial Neural Network based Technology is inspired by Biological Neural Networks. Artificial neural networks properties are briefly given below:-

Process Identification, Sensor Validation, Monitoring and Fault Diagnosis in Power Plants, Security Assessment and Protection , Load Identification, load Forecasting and Fault Diagnosis in Power Systems and Integrated Power System. ANN can identify and learn correlate pattern between input data set and target value. ANN are best suited for modeling of complex and non-linear problem. ANNs are constructed with layers of units thus as multilayers ANN, first layer is input layer and last layer is output layer and other is hidden layer.

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There are two types of learning in ANN are:-

Supervised learning*:* Supervised learning which incorporates an external teacher, so that each output unit is told what its desired response to input signal ought to be. During learning process global information is required. There is an issue of convergence error i.e. minimization of error between desired & computed unit values.

Unsupervised learning*:* Unsupervised learning use no external teacher and it is based only upon local information. Neural network learns off-line if the learning phase and operational phase are distinct. A neural network learns on-line and operate at the same time. Usually supervised learning is off-line and unsupervised learning is on-line. So the unsupervised learning needs no global information as well as no teacher required for the learning process [1].

Case Study

There are number of applications of artificial neural networks in the power system found fruitful for different application as detailed below:

(a) Power System protection

Several novel concepts have been introduced including ANN application to current transformer (CT) and capacitor voltage transformer (CVT) transient correction, fuzzy criteria signals, fuzzy settings and multi-criteria decision making for digital relays. Differential protection for power transformers is selected as an important example to show efficiency of the proposed concepts of fuzzy logic (FL) and ANN application.

Three major families of AI techniques are considered to be applied in modern power system protection

· Expert System Techniques (XPSs),
· Artificial Neural Networks (ANNs),
· Fuzzy Logic systems (FL).

The expert systems included few heuristic rules based on the expert's experience. In such systems, the knowledge takes the form of so called production rules (knowledge base). A generic inference engine uses the facts and the rules to deduce new facts which allow the firing of other rules. The knowledge base is a collection of domain-specific knowledge and the inference system is the logic component for processing the knowledge base to solve the problem. Fuzzy logic and ANN application to differential transformer protection. The differential relaying principle in the case of a power transformer shows certain limitations - detection of a differential current does not provide a clear distinction between internal faults and other conditions. Inrush magnetizing currents, stationary over excitation of a core, external faults combined with saturation of the CTs and/or CTs and protected transformer ratio mismatch are the most relevant phenomena which may upset the current balance causing the relay to maloperate. Application to C.T. & C.V.T. The correction function and the transfer function of CT set up in series should assure

identity of CT primary and compensated secondary currents. Since the CT's transfer function is nonlinear, usage of the nonlinear artificial multilayer neural network structure with some form of feed-back (recurrent network) is fruitful. One of the initial developments in application of ANNs for protecting transmission lines was the design and implementation of a fault direction discriminator. This ANN based directional relay used sampled values of voltages and currents, processed them to determine if a fault is on the line side of the relay or is on the bus side of the relay. Patterns from all three phases system was tested by using data obtained from simulations performed on the EMTDC/PSCAD software package. The use of ANN based systems for protecting generators has not received much attention so far. A recent paper presents the implementation of an ANN-based fault diagnosis scheme for generator windings According to this paper, the ANN has the ability for detecting and classifying generator winding faults with higher sensitivity and stability boundaries as compared to conventional differential relays in addition to the ability for identifying the faulted phases [2].

(b) Fault Detection

Electrical power systems suffer from unexpected failures due to various random causes. Unpredicted faults that occur in power systems are required to prevent from propagation to other area in the protective system. For isolation of the faulty line the protective relay have to send a signal to the circuit breaker. The ability to learn, generalize and parallel processing, pattern classifiers is powerful applications of ANN used as an intelligent means for detection. This paper presents ANN architecture for fault detection in a transmission line power system. Faults on electric power systems are an unavoidable problem. Hence, a well-coordinated protection system must be provided to detect and isolate faults rapidly so that the damage and disruption caused to the power system is minimized. The clearing of faults is usually accomplished by devices that can sense the fault and quickly react and disconnect the faulty section. It is therefore an everyday fact of life that different types of faults occur on electrical systems, however infrequently, and at random locations. Faults can be broadly classified into two main areas which have been designated as active and passive. Basically, we can design and train the neural networks for solving particular problems which are difficult to solve by the human beings or the conventional computational algorithms. The computational meaning of the training comes down to the adjustments of certain weights which are the key elements of the ANN. This is one of the key differences of the neural network approach to problem solving than conventional computational algorithms. This adjustment of the weights takes place when the neural network is presented with Due to the possibility of training neural networks with off-line data, they are found useful for power system applications. The neural network applications in transmission line protection are mainly concerned with improvements in achieving more effective and efficient fault diagnosis and distance relaying. ANN used for overhead transmission lines, as well as in power distribution systems This paper presents a method for detection and identification of the fault type and its zone in the line. Backpropagation neural network approach is studied and implemented.

Voltages and currents signals of the line are observed to perform these three tasks. The detailed coefficients of all phase current signals that are collected only at the sending end of a transmission line are selected as parameters for fault classification. The transmission line models are constructed and simulated to generate information which is then channeled using the software MATLAB (Version 7) and accompanying Power System Block Set (Version 2.1). Besides Neuroshell-2 software used to provides back-propagation neural networks [3].

(c) Restoration of Power System

Automatic restoration method in which the development and application of programs is done through computer programs and no role of **system operator**. Supervisory control and the data acquisition system (SCADA) and the energy management system (EMS) are the main sources of data. The PSR program is installed which then develops a restoration strategy during the blackout. Organized based on the power system data provided by the SCADA/EMS by the system operator, circuit breaker and switches. After this a switching sequence program is further liable to transmit the control signals to the circuit breakers and the switches via the SCADA. In computer aided restoration system, operator is the one who is involved in the advancement and operation of the PSR plan. The data source is again local SCADA/EMS in this case. The PSR plan is following a wide area disturbance and it then formulates the restoration plan. The transmission of the control commands is done for the application of the PSR using the local SCADA/EMS. In co-operative method the PSR design is suggested by the computer program which has been fed at the EMS after the blackout has occurred. SCADA/EMS serves again as the data source and the system operator is the one who operates the PSR program. During blackout the restoration plans will be formulated by this [4].

(d) Load Forecast

Load forecasting plays a very important role for economic, efficient and reliable operation of a power system. If the load forecasting is accurate and reliable then huge amount of money can be saved in expansion as well as construction of power system.

Load forecasting broadly divided into three categories as given below.

- Short-term load forecasting over an interval ranging from an hour to a week is important for various applications such as unit commitment, economic dispatch, energy transfer scheduling and real time control. It is difficult to find functional relationship between all attribute variable and instantaneous load demand, difficulty to upgrade the set of rules that govern at expert system and disability to adjust themselves with rapid nonlinear system-load changes.
- Mid-term load forecasting that range from one month to five years, used to purchase enough fuel for power plants after electricity tariffs are calculated.
- Long-term load forecasting (LTLF), covering from 5 to 20 years or more, used by planning engineers and economists to determine the type and the size of generating plants that minimize both fixed and variable costs. Main advantages

of ANNs that has increased their use in forecasting are as follows:

1. Being conducted off-line without time constrains and direct coupling to power system for data acquisition.
2. Ability to adjust the parameters for ANN inputs that has not functional relationship between them such as weather conditions and load profile [5].

(e) Economic Load Dispatch

The economic operation of power system involves the solution of two different problems. The first of these is unit commitment and second is economic dispatch(ED). The economic dispatch problem (ED) of power system is to determine the optimal combination of power outputs for all generators, which minimize the total fuel cost while satisfy the constraints. Conventional methods for solving ED problems are Lambda iteration method, gradient decent method etc. The main drawback of these methods is that as size of power system grows, the required computational time also grows therefore these methods cannot be used for on-line application. In recent years, Hopfield Neural Network approach has been used to solve economic dispatch of power system. In this approach, the objective function of ED problem along with constraints is transformed into an Energy function 'E', called Hopfield Energy function. This energy function has been minimized through iterative process by the Hopfield dynamics.

- The economic dispatch model

The economic dispatch problem can be mathematically described as follows:

$$\underset{P_i}{\text{Min}} \sum_{i \in N} F_i(P_i) = \underset{P_i}{\text{Min}} \sum_{i \in N} (a_i + b_i P_i + c_i P_i^2)$$

Subjected to the following constraints:

- Power balance constraint i.e.,

$$\sum_{i \in N} P_i = P_D + P_L$$

- Generation limit constraint i.e.,

$$P_{i\,min} < P_i < P_{i\,max}$$

where,

i : Index of dispatchable units

$F_i(P_i)$: input-output cost of function of unit i

P_i : The generated power of unit i

a_i, b_i, c_i : Cost coefficient of unit i

N : Number of dispatchable units

P_{imin} : Minimum generation limit of unit i

P_{imax} : Maximum generation limit of unit i

P_D : Total load demand

P_L : Transmission line losses

The losses may be represent by loss formula

$$P_L = \sum_{i=1} \sum_{j=1} P_i B_{ij} P_j + \sum B_{i0} P_i + B_{00}$$

where,

B_{ij} , B_{i0} , B_{00} : Transmission line coefficient.
Incremental loss of unit i at power generation P_i is defined as

$$I_{Li} = \frac{\Delta P_L}{\Delta P_i} = 2 \sum_{J=1}^{N} B_{ij} P_j + B_{i0}$$

Hopfield model is a mutual coupling neural network having nonhierarchical structure. Dynamic characteristics of each neuron of the continuous Hopfield neural network is described by following differential equation.

$$\frac{dU_i}{dt} = \sum_j T_{ij} V_j + I_i$$

where , U_i : input of neuron i
T_{ij} : Interconnection conductance from output neuron j to the input of neuron i.
T_{ii} :Self connection conductance of neuron i.
I_i : External input to neuron i.
V_j :output of neuron j
The Energy function is defined as

$$E = (-1/2) \sum_i \sum_j T_{ij} V_i V_j - \sum_i I_i V_i$$

The time derivative of the energy function is negative. Therefore, in the computational process, model state always move in such a way that energy function gradually reduces and converges to the minimum [6].

Conclusion

Application of ANNs in power system have been reviewed & ANNs for power system should be viewed as an additional tool instead of a replacement for conventional or other AI based power system techniques Fault detection, classification and location in transmission line system have been investigated using neural network & ANN is powerful tool for decision making in electric distribution companies regarding load consuming. The use of artificial intelligence that is the computer aided programs for energy restoration has increased. The system operator is liable to make misjudgments considering the stress and short time limit required for the restoration. ANN is one such method and has proved to be highly effective to be used for restoration power system.

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Different Control Techniques of Wind Turbine Inverters

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Abstract: The wind turbine technology is one of the most emerging renewable technologies. It started in the1980'es with a few tens of kW production power to today with Multi-MW range wind turbines that are being installed. This also means that wind power production in the beginning did not have any impact on the power system control but now due to their size they have to play an active part in the grid. The technology used in wind turbines was in the beginning based on a squirrel-cage induction generator connected directly to the grid. By that power pulsations in the wind are almost directly transferred to the electrical grid. Furthermore there is no control of the active and reactive power, which typically is important control parameter to regulate the frequency and the voltage. As the power range of the turbines increases those control parameters become more important and it is necessary to introduce power electronics as an interface between the wind turbine and the grid. The power electronics is changing the basic characteristic of the wind turbine from being an energy source to be an active power source. The electrical technology used in wind turbine is not new. It has been discussed for several years but now the price pr. produced kWh is so low, that solutions with power electronics are very attractive.

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Introduction

Wind energy is a prominent area of application of variable-speed generators operating on the constant grid frequency. Wind energy is now firmly established as a mature technology for electricity generation and over 13,900 MW of capacity is now installed, worldwide. It is one of the fastest growing electricity generating technologies.

Why and Where Inverters Used in Wind Turbine?

In this paper will first discuss the why and where inverters used in wind turbine. Variable-speed wind turbines have progressed dramatically in recent years. Variable-speed operation can only be achieved by decoupling the electrical grid frequency and mechanical rotor frequency. To this end, power-electronic inverters are used, such as an ac–dc–ac inverter combined with advanced control systems. Pulse Width Modulation variable speed drives are increasingly applied in many new industrial applications that require superior performance. Variable voltage and

frequency supply to a.c. drives is invariably obtained from a three-phase voltage source inverter.A number of Pulse width modulation (PWM) schemes are used to obtain variable voltage and frequency supply. The most widely used PWM schemes for three-phase voltage source inverters are carrier-based sinusoidal PWM,Hysteresis type modulation and space vector PWM (SVPWM).
Nowadays generally hysteresis type modulation is used in inverters but, There is an increasing trend of using space vector PWM (SVPWM) because of their easier digital realization and Better dc bus utilization. This project focuses on step by step development SVPWM implemented on an Induction motor.
The model of a three-phase a voltage source inverter is discussed based on space vector theory. Simulation results are obtained using PSIM.

Controlling a wind turbine involves both fast and slow control. Overall the power has to be controlled by means of the aerodynamic system and has to react based on a set-point given by dispatched center or locally with the goal to maximize the production based on the available wind power.
Below maximum power production the wind turbine will typically vary the speed proportional with the wind speed and keep the pitch angle fixed. At very low wind the speed of the turbine will be fixed at the maximum allowable slip in order not to have over voltage. A pitch angle controller will limit the power. When the turbine reaches nominal power. The generated electrical power is done by controlling the doubly-fed generator through the rotor-side converter. The control of the grid-side converter is simply just keeping the dc-link voltage fixed. Internal current loops in both converters are used which typically are linear PI-controllers, as it is illustrated in Fig. 1. The power converters to the grid-side and the rotor-side are voltage source inverters.

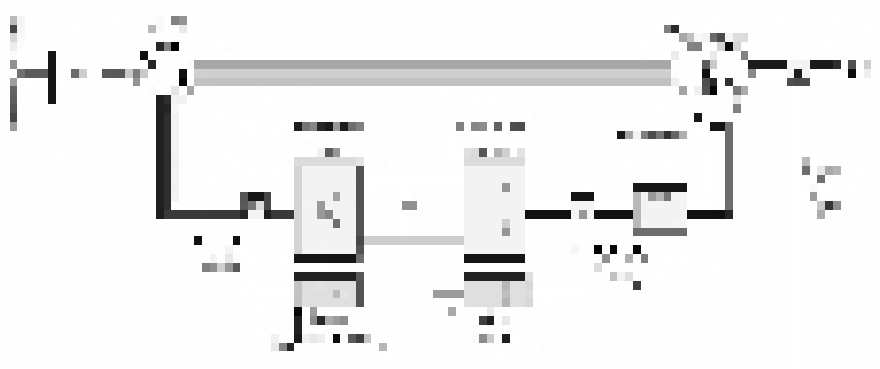


Fig 1. Doubly fed Induction generator system

Another solution for the electrical power control is to use the multi-pole synchronous generator. A passive rectifier and a boost converter are used in order to boost the voltage at low speed. The system is industrially used today. It is possible to control the active power from the generator. The topology is shown in Fig. 2 A grid inverter is interfacing the dc-link to the
Grid. Here it is also possible to control the reactive power to the grid. Common for both systems are they are able to control reactive and active power very fast and thereby the turbine can take part in the power system control.

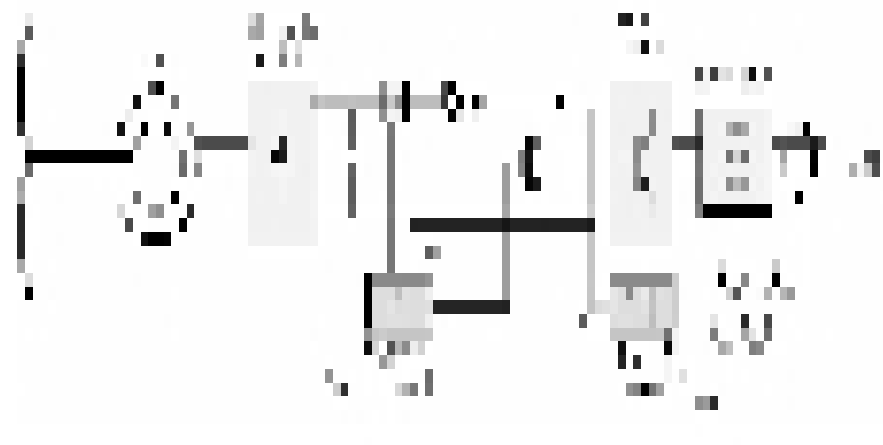


Fig 2. Control scheme for Permanent magnet generator

The power control system should also be able to limit the power.
An example of an overall control scheme of a wind turbine with a doubly-fed generator system is shown in Fig. 3

Fig 3. Control scheme of DFIG

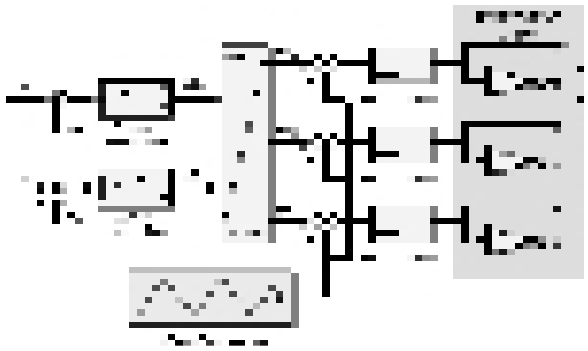
The forced switched power-inverter scheme is shown in Fig. 4. The converter includes two three-phase ac–dc converters linked by a dc capacitor battery. This scheme allows, on one hand, a vector control of the active and reactive powers of the machine, and on the other hand, a decrease by a high percentage of the harmonic content injected into the grid by the power converter.

Fig. 4 Single doubly fed induction machine with two fully controlled ac–dc power inverters.

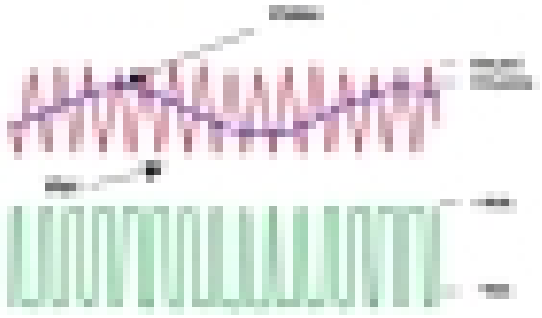
Different control techniques of Inverter used in wind Turbine.

- SPWM [Sinusoidal pulse width modulation]
- Hysteresis Current Controller
- SVPWM [space vector pulse Width modulation]

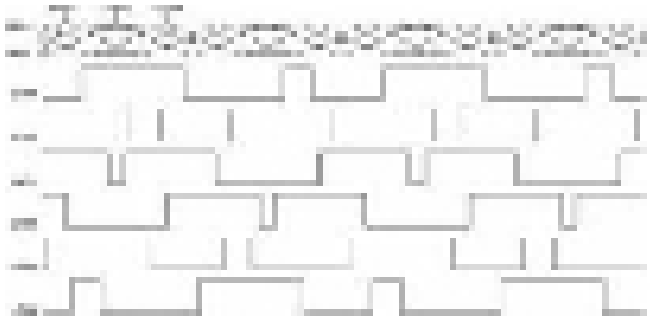
Sinusoidal Pulse Width Modulation in Inverters



In SPWM the most straightforward implementation, generation of the desired output voltage is achieved by comparing the desired reference waveform (modulating signal) with a high-frequency triangular 'carrier' wave as depicted schematically in Fig.



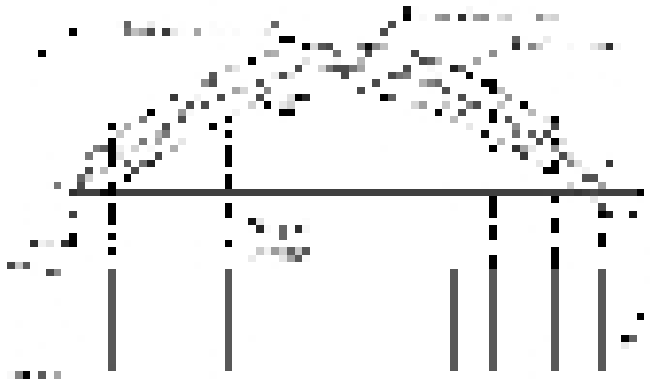
Output voltage from an inverter can also be adjusted by exercising a control within the inverter itself. The most efficient method of doing this is by pulse-width modulation control used within an inverter. In this method, a fixed dc input voltage is given to the inverter and a controlled ac output voltage is obtained by adjusting the on and off periods of the inverter components. This is the most popular method of controlling the output voltage and this method is termed as Pulse-Width Modulation (PWM) Control.

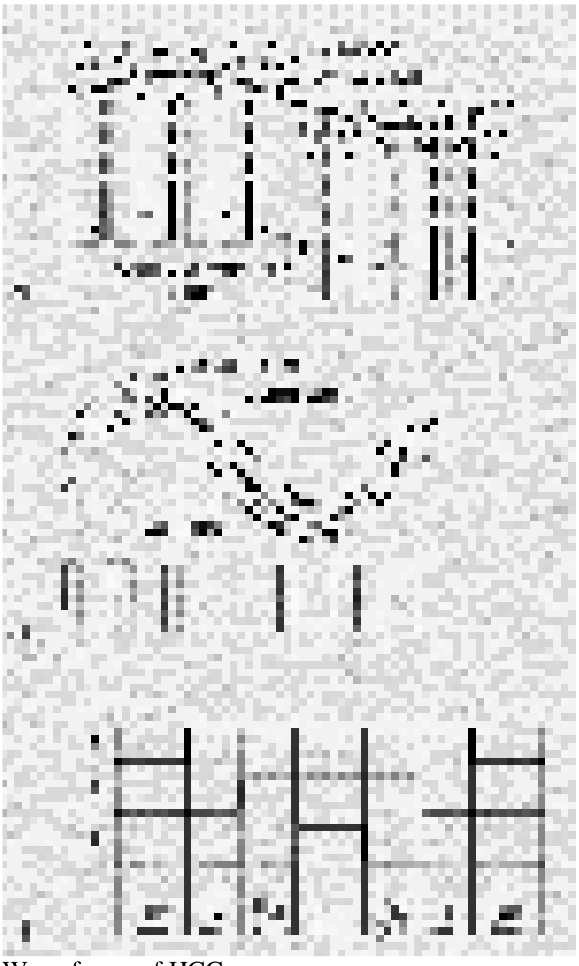


3". SPWM wave form

Hysteresis Current Controller

Conventional hysteresis current control operates by comparing a current error (i.e. the difference between the demanded and the measured phase current) against fixed hysteresis bands. When the error exceeds the upper hysteresis band, the inverter output is switched low, and when the error falls below the lower hysteresis band, the inverter output switches high. This process is illustrated in Figure 1, and is usually implemented using two level switching so that each phase leg output is the mirror image of the other.





Wave forms of HCC

The basic scheme of a single-band hysteresis current controller is shown in Fig In this case; the inverter will produce a Positive output voltage when the current error touches the Lower hysteresis limit. On the other hand, a negative output Voltage is produced when the current error touches the Upper hysteresis limit. The output voltage waveform under this current controller is shown below.

- Working of HCC

In general, the output voltage expression can be written as follows

The output voltage and current can be decomposed into the Average (averaged over one switching cycle) and ripple components as follows

For the current, the average value is equal to the reference and the ripple component is equal to the error component. If (2) and (3) are substituted into (1), then the following is obtained

As the average and ripple components on the left-hand and Right-hand sides of (4) must be equal, the following Equations can be obtained

The ripple voltage drop across the load resistance R~ io is Usually small and can be neglected and, hence, (6) can be simplified into

Thus, the output current ripple can be calculated as follows

The average value of the output voltage can be assumed to Vary sinusoidally at the fundamental output frequency

Where k ¼ Vm/Ed is the modulation index.
When the transistors Q1and Q4 receive ON signals, a Positive output voltage is produced, vuv ¼ Ed. This ON Period lasts until the output current error reaches the upper Hysteresis limit. Thus, during the ON period, the current error is changing from 2h to þh. Based on (8), the following Expression can be obtained.

Where TON is the ON period of switches Q1and Q4. Based on (10), the ON period can be obtained as follows

During the OFF period, that is, when transistors Q1and Q4 receive OFF signals (transistors Q2and Q3 receive ON signals), the output voltage is negative, Vuv ¼Ed. During this period denoted by TOFF, the current ripple changes from h to 2h, that is

Based on (12), the OFF period can be calculated as

Based on (11) and (13), the switching period can be calculated as

By using (9) and (14), the switching frequency can be obtained as

The average switching frequency over one fundamental period is

Where

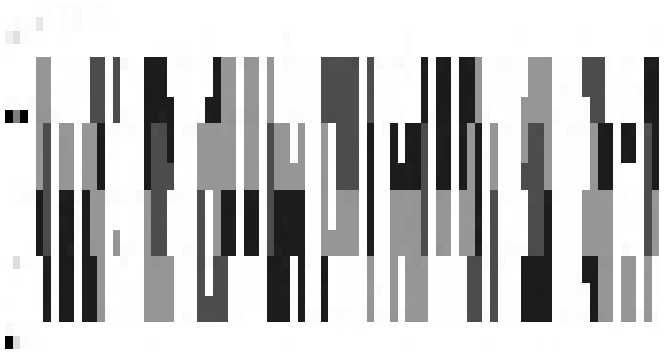
Is the maximum switching frequency? The rms value of the current ripple is constant at

Under a hysteresis current controller, the output current ripple is constant but the average switching frequency varies with the modulation index. The average switching frequency will be maximum when the modulation index is zero.

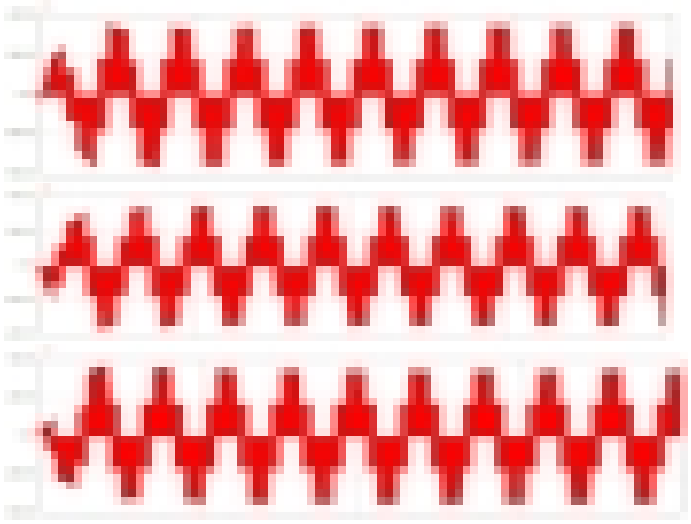
Simulation Results in PSIM environment

Load side current waveforms for each phase

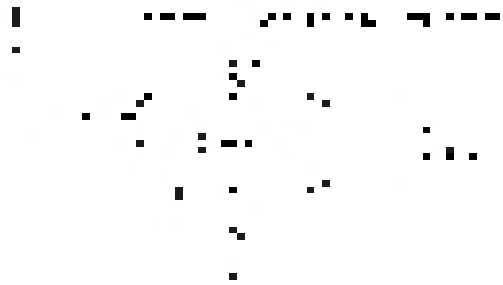
Load side voltage waveforms for each phase



Individual waveforms from load side

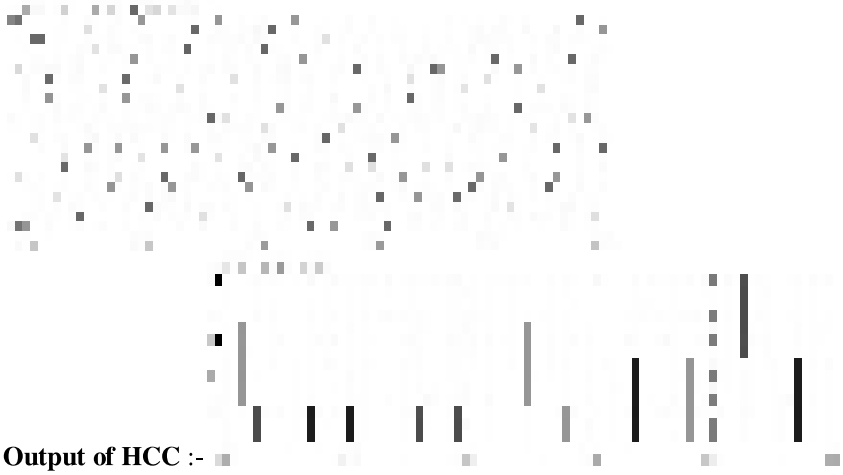


Hysteresis Current Controller Power Circuit (HCC):-



HCC Waveform for 1-phase:-

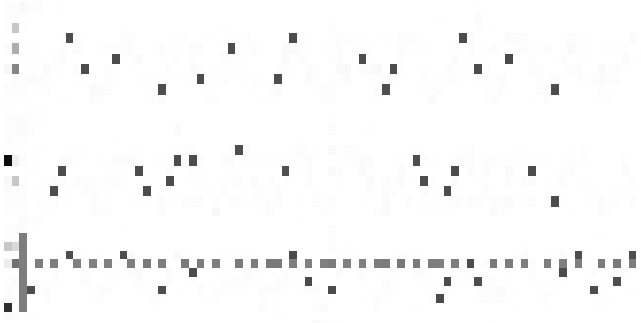
HCC Waveform for 3-phase:-



Output of HCC :-

HCC controller load side current waveforms: -

HCC controller load side voltage waveforms(for each phase):-



Conclusion

This study has discussed the two most popular control methods for Grid Connected Inverters, 1) SPWM, 2) Hysteresis Current Controller technique. In comparison the SPWM technique is more difficult in large Grid Connected Inverters, where switching frequency is not high enough, as the result filtering of output may difficult and expensive in SPWM. For this reason the Hysteresis Controller is used. Regardless of undesirable harmonic spectrum, if null wire connection be accessible, Hysteresis Controllers can be implemented easily, and will be good choice due to its transient response.

A new hysteresis current controller that is suitable for a single-phase full-bridge inverter has been proposed in this paper. The proposed hysteresis current controller has successfully combined the advantages of both the conventional double-band hysteresis current controller (fast response) and symmetrical unipolar PWM (better waveform). Switching frequency expressions that are useful in the design of hysteresis current controllers have been derived. For the same hysteresis band, the average switching frequency of the inverter under the proposed hysteresis current controller is much lower than that of conventional hysteresis controllers. By using the proposed current controller, the capability of inverter switching devices can be fully utilized to improve the inverter output current waveform. Simulated and experimental results have verified the effectiveness of the proposed current controller under transient and steady- state conditions. Applications of the proposed current controller to bidirectional rectifiers, UPSs, and multilevel inverters are under investigation.

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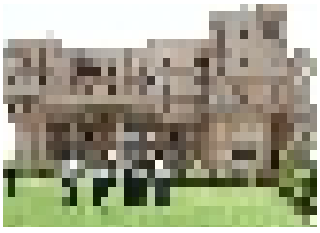

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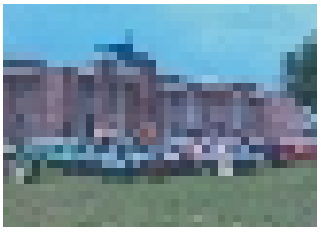

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