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Basic Food Safety Monitoring And Enhancement in Coffee Industry Using IOT

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Abstract - Towards the modernization of various process involved in manufacturing a product, IOT plays a vital role in developing the food product under hygienic conditions without any cross contamination throughout all the stages. The manual handling results in the contamination of the food product during the various stages of manufacturing. This also leads to unhygienic way of preparation. Under this observation, IOT paves a suitable pathway for developing the food product in a structured manner pertaining to the coffee roasting. This paper provides solution on development carried out in coffee making industries for ensure efficient hygienic operation implemented in that industry.

Keywords: IoT; food safety; coffee industry

I. INTRODUCTION

Food safety is a scientific discipline, describing, handling, preparation and storage of foods in various ways that will prevent the borne illness. The occurrence of two or more cases of a similar illness results from ingestion of a common food. The cases may be due to unhygienic handling of food products, improper preparation, preservation and storage of food.

In order to overcome these basic and common issues, the food products can be handled in hygienic manner such as placing them under dry atmospheric conditions. Normally, hot foods are maintained at a temperature of greater than 60oC while the cold foods are maintained at a temperature less than 4oC. Ever since the use of software taps into the existing plant sensors, PLCs and SCADA systems to collide the most critical parameters, the system provides intelligent alerts via push notifications to identify the fault conditions and enable immediate actions. It can monitor and grab the behavior through trends and alert reports. The IoT network in the food supply chain significantly aids to trim down the waste, costs, and risks. Each function of the various food areas can get better with the integration of IoT devices [1]. In industries especially food industries, IoT devices and its allied components can significantly improve traceability, enhanced collaborated operation with multi sector operations, allow remote access and enhanced automation opportunities [5]. This paper describes the replacement of existing manual handling operation of coffee roasting into an automated handling in coffee industries. Recently most of the industries rely on IoT for end to end transparency.

II. EXISTING HANDLING IN COFFEE ROASTING

Manual handling of food products in a wide range is the prevailing situation in most of the industries. In figure 1 shows the manual handling operation of weighing in coffee industries.

Figure. 1. Normal Operation in coffee industry for weighing operations

The process looks quite comprehensive when the food products are getting manufactured during the conversion of raw material into a finished consumable product. The roasting of coffee beans is the process of converting the green coffee beans into brownish roasted coffee beans under suitable required temperature. Normally the roasting process takes place in a cylindrical drum that is capable of withstanding 180-200oC. The green beans are being pulled out from the gunny bags and it is being dumped into the primary storage hopper where it has been transferred into the secondary hopper through blower operation [2-4].

Followed by this operation, the beans are transferred into the cylindrical roasting drum where the green beans will be converted to brownish roasted coffee beans. These roasted beans will be collected in the cooling chamber that will be cooled under room temperature for 10-15 minutes. This process involves manual handling for transferring the beans to the woven sac.

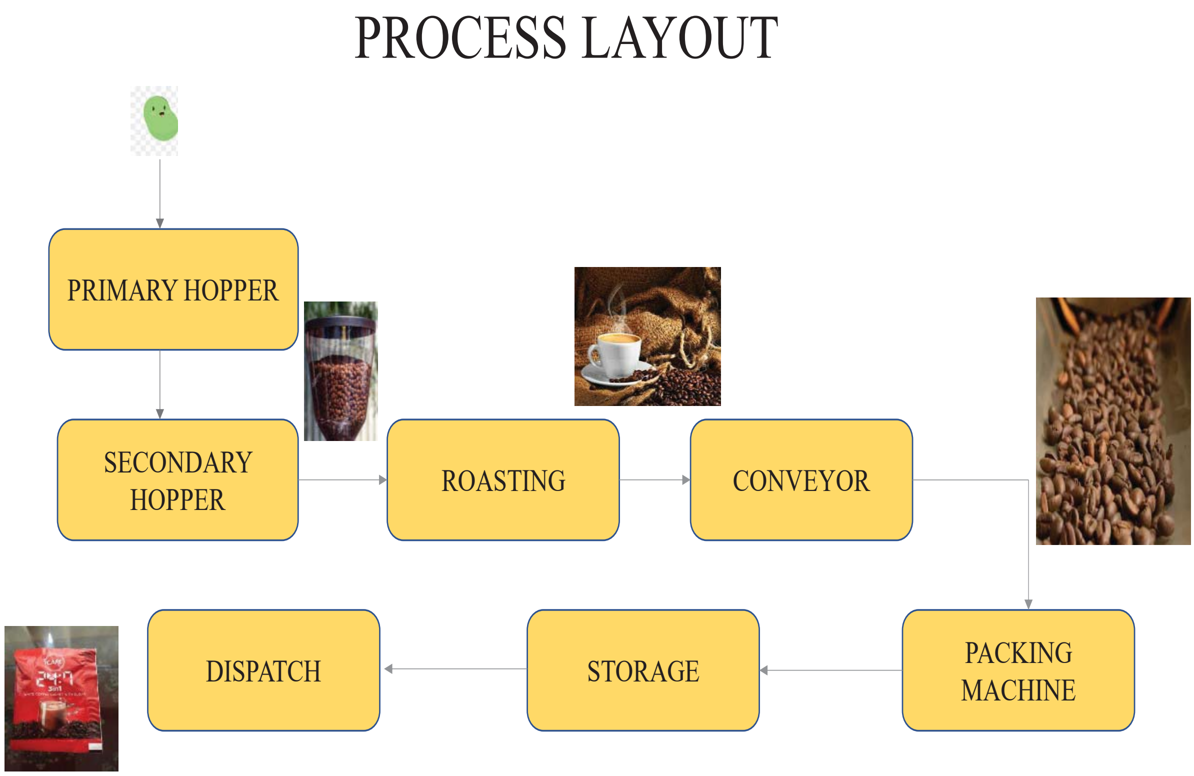

Figure. 2. Process Layout for Manufacturing Coffee

Figure 2 shows the process layout of coffee manufacturing. The roasted beans will be stored in the SS304 (stainless steel) hopper/vessel for the chemical reaction, namely degassing to take place. It is a chemical reaction which releases the carbon dioxide from the roasted beans to the atmosphere. Then it is followed by the manual transfer of the beans into pouches for the consumers based on the volume criteria.

III. MODERNISATION USING IOT

The internet of things is a network of physical device which enables the control method of food preparation and enhancing the food packaging. It is a system of inter-related computing devices which includes electrical and mechanical arrangements that are provided with the unique identifiers. These identifiers are used for inter-relating the data irrespective of the operation between the system provider and the human communication [8]. Weighting functions shown in figure 3.

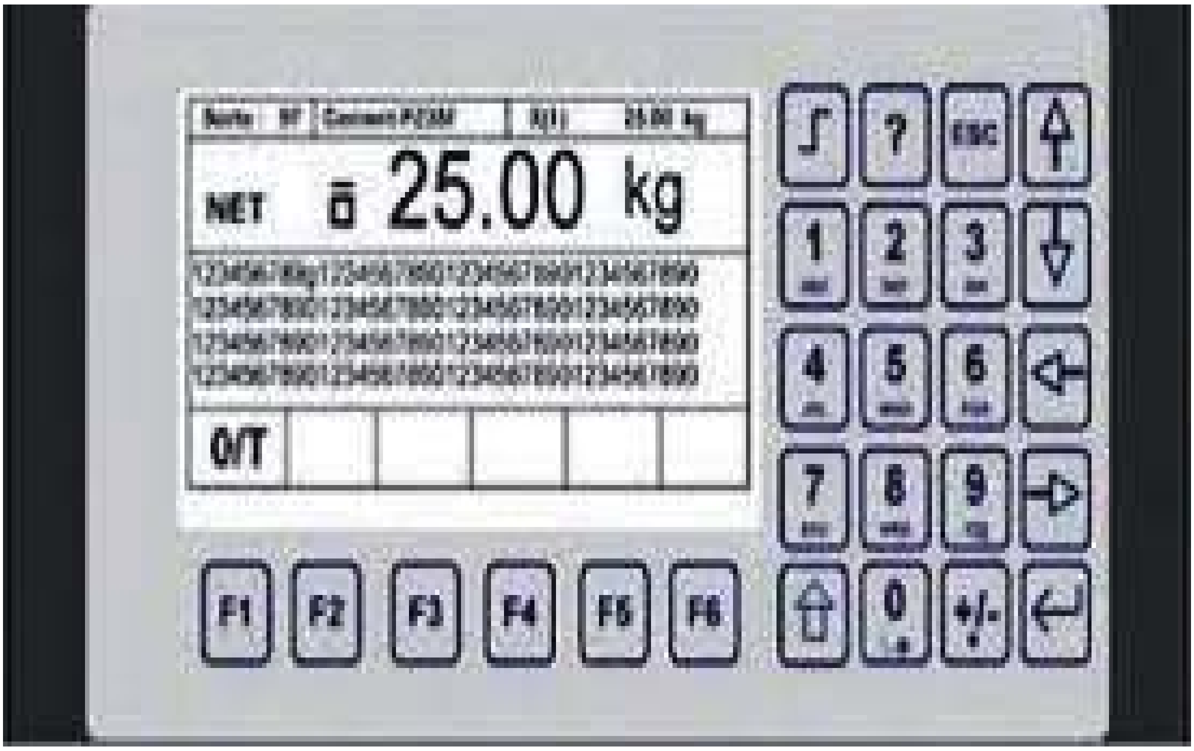

Figure. 3. IoT Operation inbuilt in coffee industry for weighting functions

The green beans are dumped to the primary hopper by manual dumping. The use of IOT helps in storing large amount of green beans in the primary hopper. This is followed by the transfer of beans from the primary hopper to the secondary hopper with the help of aspiration blower. The required bag size is being maintained in the secondary hopper for the roasting to take place. This operation improves the quality of roasting by avoiding the excess volume of intake to the roaster.

The roasting operations take place under the cycle time for the conversion of green beans into roasted beans at a desired temperature, stages of heating proportion under burner operation and quenching of water. Here the implementation of IOT is carried out through PLC and SCADA interface. The programs are fed under the preparation of this recipe which helps to monitor each and every stage of the roasted beans [6].

Further proceeding towards the storage of roasted beans that is collected from the cooling chamber, the temperature sensor senses the temperature of the roasted beans and the timer monitors the cooling time of the beans which regulates the signals for the storage condition of the beans. Here the beans are monitored for the degassing stages under the presence of sequential timer.

The beans will be moved through the SS cylindrical hollow pipe with the help of a spiral conveyor that is governed by a flexible rope which is supported by a modular bush which is used to transfer the beans to the final stage of packing hopper. The modular system is used to safeguard the roasted beans from getting broken during the transfer stage [7,8]. The movement of beans is controlled by the velocity of the blower.

The final stage focuses on packing of the roasted beans. The beans are allowed to fall under the gravitational force of the desired volume by the chute. The pouches are placed parallel to the flow of beans and the filling of the beans is controlled by the check weigher. The hydraulic system is used to cut off the flow of beans from the hopper to the pouches and once when the desired quantity is filled in the pouch the pneumatic system helps to cut off the flow of beans. The pouches are flushed with the nitrogen air in order to improve the shelf life of the roasted beans and also enabling the long-lasting of the product.

Followed by the nitrogen flushing the filled pouches are immediately sealed under desired temperature to get converted into a finished product. The temperature monitoring and controlling is carried through the help of sensors. The pouches will be moved from the chamber and the label is pasted when the pouches move through the conveyor.

The labelled pouches flow in a sequence to the desired corrugated box and once when the box gets filled, it automatically gets sealed and it’s been shrink wrapped as the final stage of the product.

IV. RECOMMENDATIONS

The above recommendation has been discussed in coffee industries to enhance the operational flow right from raw material loading and unloading, roasting and grinding operations till packing operations. IoT is a low cost modern technology suitable for various operations in coffee industries.

V. CONCLUSION

The food product is being processed and packed by a human programming with the mechanical and electrical arrangements by avoiding the direct contact of the human. The beneficial aspects of implementing the IOT are mainly to produce the hygienically developed safer product. It also enhances the productivity at reduced time and minimal manufacturing space. This in turn results in the profitable growth for the investor.

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Insulators compounded with Nano Particles

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Abstract* – The underground cables and overhead cables play a major role in transmitting the electrical power. The transmission of power for long distances takes place with the help of insulators. They help in insulating the conductors from the ground. The mechanical strength, electrical resistance and relative permittivity are high in insulators and this forms the basic characteristics. Normally the insulators are also ensured that they are free from impurities. The presence of impurities can result in breakdown whenever there is a transient resulting by flashover or puncture. The strength of insulators can be enhanced by incorporating the nano particles into the polymers during the manufacturing stage of the insulator. The dielectric breakdown strength gets increased when Aluminum oxide nano powder is incorporated as it enhances the heat transfer and also acts as a coolant.

***Keywords* – Insulator, Nano Powder, Nano Particle**

I. INTRODUCTION

Transmission line conductors are bare and do not have any insulated coating over it. To maintain safety and necessary clearance between live conductors and metal structure of the support, insulators are mounted. Insulators are also used in providing support to bus bar conductors and other live high voltage equipment terminals. The generation side has costlier alternators that have properly insulated windings and also the distribution side that has power cables which are suitably insulated from the supports. The commonly used insulating materials are porcelain, glass and synthetic resin. Porcelain is a ceramic material and are used in supporting of live conductors while glass insulators are used for EHV AC and DC systems [1-3]. Synthetic insulators are used in indoor applications.

II. INSULATION FAILURE

Failures are quite common when it comes to any product that is put into use. The failure prevention is a major concern for a product to make its place in the market. When it comes to insulators, the major failures may occur due to the abnormal stress developed, minor cracks resulting into major deterioration, flashover and ageing. When a particular portion of the insulator is subjected to the flow of leakage current, it may heat up the localized portion and may result in failure. The pollutants, rain droplets, dust particles, smog may result in the deposition of materials on the surface of the insulator. This in turn reduces the dielectric strength of the insulator and also increases the surface leakage current. During any such occurrences, the excess heat generated will have the potential to destroy the insulator permanently [9]. The heat generation can be reduced by incorporating the aluminum oxide nanoparticles during the manufacturing stage itself [4,6]. Aluminum oxide nanoparticles will act as a coolant thereby removing the generated heat because of its high thermal conductivity.

III. PROBLEM IDENTIFICATION

The insulators are exposed to the environmental conditions on all occasions. Due to this exposure, the dust particles get settled down on the surface of the insulators. Under rainy conditions, these dust particles along with water droplets makes an impact on the insulator surface. This impact represents the weak zone and it results in a puncture when the insulator loses its strength. In order to enhance the strength aluminium oxide nano powder particles are incorporated into the polymer. Some nanoparticles also possess self-cleaning property. The breakdown also occurs due to thermal and mechanical loading of the insulators. At some circumstances, the breakdown may be due to the improper selection of the polymer[5].

IV. SYNTHESIS OF AL2O3 NANOPARTICLE

The metal oxide nanoparticles have their specific identity based on their physical and chemical properties due to the particle size variation [7,8]. When the particle size gets reduced further, the properties also start varying. Here the aluminium oxide nanoparticle is considered to be synthesized so that these particles have the ability to increase the thermal conductivity, dielectric strength and also acts as a coolant. 1.32gm of Al_2Cl_3 is mixed with 10ml $NH_4OH$and is maintained to be left at room temperature for 30 minutes as shown in Fig 1.

Fig.1. Sample measurement

This solution is mixed with 40ml of water and the resultant obtained is a clear solution which runs under stirrer operation as shown in Fig. 2.

Fig.2. Sample under stirrer operation

The addition of 5ml of ethanol results in gel formation and so this method is commonly called as sol-gel method. The resultant exists in the form of gel which is retained room temperature for almost 30 hours as shown in Fig.3.

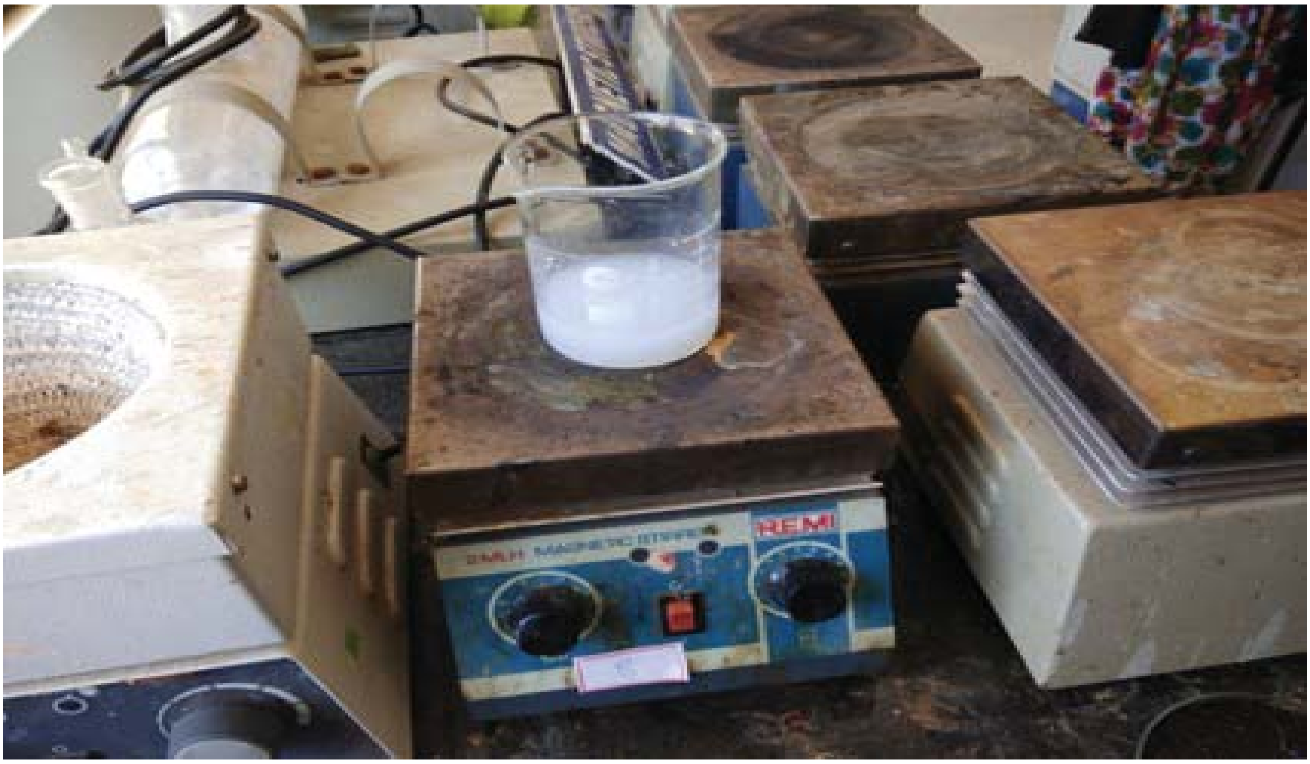

Fig.3. Gel formation

The evaporation of the sample carried out by using a furnace which is maintained at 100oC for a couple of days. Finally, the dried sample is again kept in the furnace at 1000oC so that the total moisture content gets eliminated.

The resultant sample is a white crystalline powder which is examined under scanning electron microscope to determine whether the obtained particles belong to the size of nanoparticles and also to confirm whether the particles belong to the family of aluminum oxide nanoparticles.

V. POLYMER PREPARATION

115g of polyurethane pellets are mixed with (Lord 7545 A/D) adhesive so that the elastomer can be prepared. Under suitable varying proportions Al2O3 element ((10, 20 & 30 percentages) by volume) is fed in to the polyurethane and it is well mixed till it forms a slurry. Followed by this step, the slurry is poured into the Teflon mould (the selected cavity size is 75 mm x 12 mm x 12 mm). The property of low magnetic permeability is highly a concern separately from the viscoelastic properties of the polymer. Three types of samples were prepared. Sample1 which one is not aligned elastomer is not cured in the applied magnetic field. The remaining two samples namely called as sample2 and sample3 are cured in the given constant magnetic field for which the alignment of Al2O3 particles is i. Parallel ii. Perpendicular to the direction of load applied during tensile studies respectively. The samples are tested under magnetic field only to realize the molecular performance of the polymer sample. Polyurethane is the selected polymer and the nanoparticles are incorporated so as to analyse the behavior under various testing conditions.

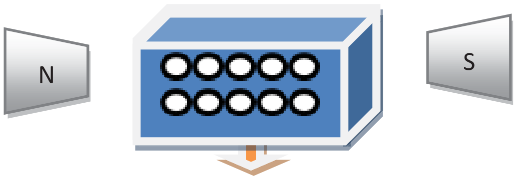

Fig.4. Isotropic Magnetic Elastomer

In this type of method (figure 4) , Load can be applied in 90degree with the applied magnetic field

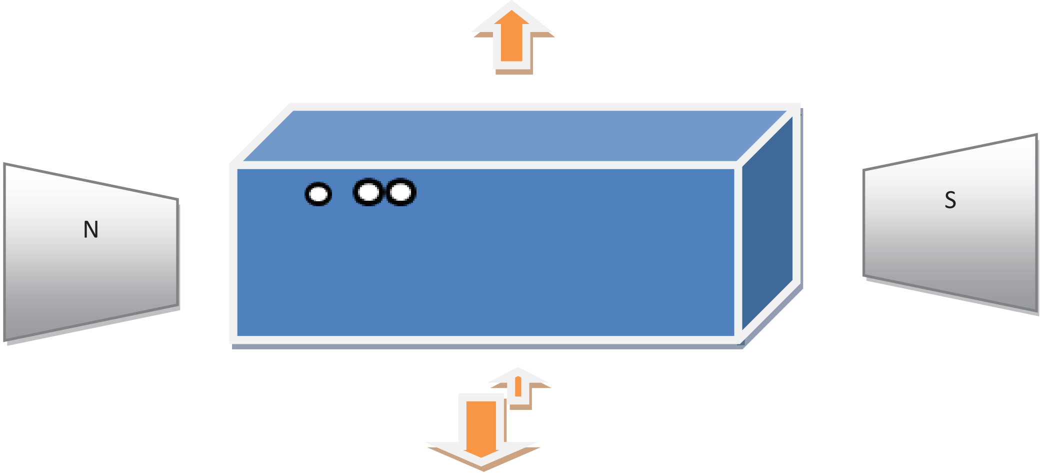

Fig.5. Anisotropic Magnetic Elastomer

Here (figure 5) load is applied parallel or same with the direction alignment.

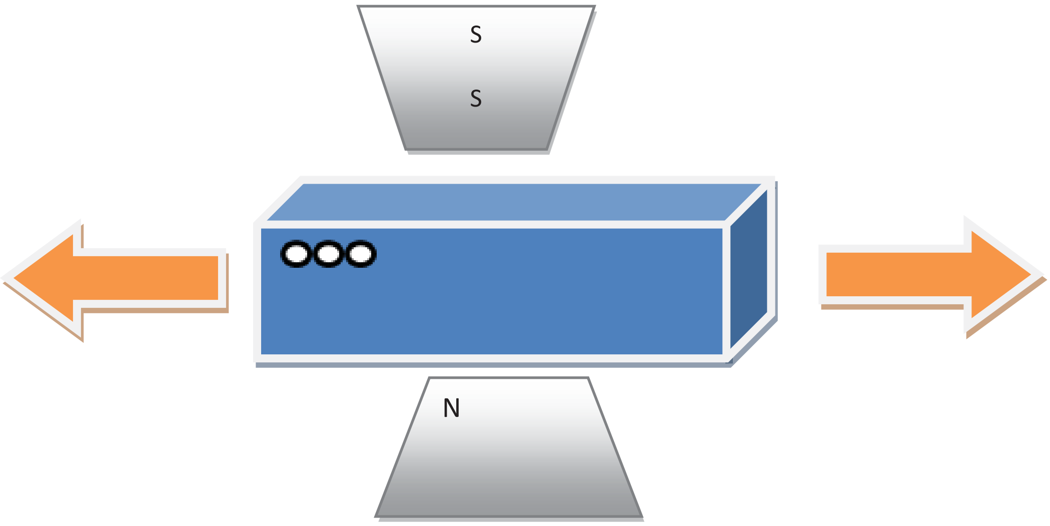

Fig.6. Anisotropic Magnetic Elastomer

In figure 6, the load will be applied in perpendicular with its alignment direction. Figures 4,5,& 6 are taken from google images.

VI. RESULTS

The polymer samples will be tested with respect to all the insulator tests as per the standards. The testing of the sample will be carried out in two sequences like without nanoparticles and with nanoparticles. The testing includes mechanical tests, electrical insulation tests, environmental tests, temporary cycle tests and corona and radio interference tests. Initially hardness of the sample will be analyzed so that it can be further proceeded for dielectric tests and other tests respectively. The test will be conducted with a reference sample that is made up of polyurethane only. The results of this reference sample will be compared with the sample prepared with impinging aluminium oxide nanoparticles. By varying the composition of aluminium oxide nanoparticles added to the sample, the best sample will be selected based on the dielectric strength.

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Quality Span Prediction (QSP) of Solar Photovoltaic Panels

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Abstract— **One of the most beneficial systems to generate green energy are the solar panels. At present various types of photovoltaic panels are in use depending on the energy requirement of the user. But, all panels are not in good conditions. Sometimes the users are supplied with very old and degraded quality panels. This reduced the power production of PV panels which are lower than their rated value. So the users have to install a new PV system within a very short span of time. Hence the choice of solar power system is decreasing in certain regions. This paper is focused on finding the age and quality of the PV panels. The quality of the PV panel is estimated by Infrared Thermal Imaging (ITI) techniques. The age of the PV panels is found out from the Normal Test Operating Condition (NTOC) values Normal Operating Cell Temperature (NOCT) values. From these NTOC, the Standard Test Condition (STC) values are derived. The deviation between them is used to derive efficiency, percentage defect and age of the panel. The findings necessitate the user to select the right PV panels for their energy production requirements. Hence the cost of reinstallation is eliminated and the selection of PV panels by users is encouraged. The panels are frequently monitored and their full life span is utilized productively.**

Keywords—Photovoltaic (PV) panels, Infrared Thermal Imaging (ITI), Normal Test Operating Conditions (NTOC), Standard Test Condition (STC), Normal Operating Cell Temperature (NOCT)

I. INTRODUCTION

The most efficient and economic technique to generate power from the nature is by the use of solar photovoltaic systems. The sun light is abundantly present and free of cost; it can be utilized in the best possible way. The combination of numerous solar panels that are arranged in a definitive order is termed as solar photovoltaic array. The natural conditions such as dust, dirt, shades of tree affect normal operation of solar panels. These natural conditions are unavoidable but they can be analyzed by implementing visual inspection and thermal camera. Solar Photovoltaic systems were adopted primarily for uninterrupted power even under critical operating conditions. An analysis was conducted on three different solar PV plants in Spain of which, two plants were a fixed array type polycrystalline silicon PV system with 4MW and 5 MW capacities. The other plant was a 1MW plant with dual tracking axis type mono crystalline silicon system. All the plants were examined for various types of voltage fluctuations and breakdowns. The breakdown was only due to maintenance of the plant. All data was collected and compared with the actual requirement. It was found that the total count of voltage fluctuations occurs more comparatively during the day time. The duration of fault also affected the performance of the PV system [1]. While connecting the PV system to the grid there were problems of voltage and frequency fluctuations due to the impact of climatic conditions. Harmonics were also injected in to the grid due to the presence of electronics convertors at the panel side. A review was made on the power quality problems and some existing techniques to eliminate them while connecting the PV system to the grid. Current was injected to the grid when the PV system is linked and when it exceeded the requirement of the user then preventive steps were taken. In general, the PV system should withstand the pre-calculated interruptions without sacrificing power quality [2].

The life cycle of various types of PV panels was estimated based on the target functionality of the PV system, consumables and its residual output [3]. The target functionality and consumables varied with respect to the type of load demand and so does the residual output. Thus the impact of the system towards the location was derived in percentage and based on this the life cycle was calculated. Higher the percentage lower was the lifespan and vice versa. Furthermore, few PV plants that were located in remote locations were monitored. Data such as temperature of the panels, surrounding atmospheric temperature, output power of the panels under such conditions were recorded. All the above data were examined to estimate the performance of the PV panels on the basis of Levelized Cost of Energy (LCOE) and Net Present Value (NPV) methods. The PV panels with solar tracking systems were found to be gainful for all sorts of applications. Payback time of five to six years was achieved [4]. But it required frequent cleaning and maintenance of the panels for achieving the result. The actual life span of the panels and its quality couldn't be derived which was the actual performance enhancing factor of the PV panels. Hence there was a need to estimate the age and quality of the PV panel.

For estimating the quality of the panels, infra red imageries of the PV panels taken from an Unmanned Ariel Vehicle (UAV) were utilized [5]. Based on the thermal images the faulty panels were identified and rearranged in different fashion in the same string. In addition to the surrounding environmental conditions and temperature, the panel connection configuration also affected the total power output of the PV system. Even though connection configuration was altered to attain the desired output, the quality of the panel was the key aspect that directly influences the output power delivered by the panel. With a faulty age old panel, we cannot obtain the rated or desired output from the PV panel. Hence determination of the age and quality of the panel was significant. The life cycle of numerous PV panels like thin film solar cells, silicon solar cells, dye sensitized solar cell, quantum dot sensitized solar cells, and perovskite solar cell were assessed. The estimation process involved three different key processes such as Cumulative Energy Demand, Energy Payback Time, and Green House Gas emission rate. From the examination it was found out that mono silicon solar cell had the highest values of CED, EPBT, and GHG emissions. The Dye Sensitized Solar Cells had lowest values of all the key processes of LCA. Yet the researches were focused on reducing the EPBT duration and GHG rate of emission [6]. A mathematical model to resolve average efficiency of inverter of a photovoltaic system was derived [7]. Linear, Lognormal and Polynomial were the three functions which were utilized to calculate the relative power. This relative power varied with varying size of the inverter and the DC output of the PV system. The response of the inverter was plotted for various sizing factor of the inverter and DC input. The output expressed increased efficiencies for higher voltages irrespective of the inverter components. Even though optimum inverter efficiency was modeled by altering the coefficients of the mathematical model, the actual inverter efficiency was entirely based on the DC output of the PV system. Because the actual age of the panel played a vital role in power production. As panel age increased, its quality could be degraded.

An investigation was conducted to identify the quality of the Solar Home System (SHS) in Bangladesh [8]. Most of the components of the SHS did not meet the board specifications. Twenty-four percent of the total PV panels that were tested had mismatch towards the panel board ratings. Similar cases were found in battery capacity, Depth of Discharge (DOD) of battery, charge controllers and short circuit protection devices. The life of the battery was entirely dependent on the DOD which varied between various manufacturers. But the charge controllers were implied to set out the DOD variations. This increased the cost of the SHS. But the charge controllers were also not proper in their function. A High Voltage Disconnect charge controller had a high voltage level higher than that specified in its panel board and vice versa. This affected the PV system performance. Future work included periodic quality checking of all the components, to aim on the relation between the technological and techno-societal factors that may influence the panel performance. In order to increase the efficiency and output power level of the PV panels, the TRNSYS application was implemented to simulate the extraction of heat from the panels [9]. A Phase Change Material (PCM) RT28HC was used along with the PV panel and various simulation outputs were derived with and without the phase change material. It was clear that the surface temperature of the PV panels with PCM was lesser than that without PCM. Simultaneously the power output of the panels with PCM was higher than the panel in which PCM was absent. It was obvious that when panel temperature was lower, the output power increased. Hence future work was concentrated on improving the material characteristics of the PCM. A novel implementation of PCM in different PV systems such as air-water solar heaters, solar thermal plants and cooking appliances were some of the recent applications [10]. It was stated that the PCM materials undergo three different states such as solid, melting and gas states. The thermal absorbing capability was good in the state of solid and melting. Hence thermal plants and such applications used this feature of the PCM. The selection of PCM was significant for appropriate application. PCM which had elevated latent heat and thermal conductivity was fit for SWH. The PCM can be used as reserve energy for the PV systems when the solar energy was deficient. But their reliability was questionable. Future research was dealt with improving the low thermal conductivity. More over in PV systems which stored their energy in batteries and these batteries had low response rates because the PV terminal voltage was varying. Here the PCM could fill the gap making the PV system even more stable. Thus further improvement was required to improve the thermal storing capacity of PCM. For such improvements to get executed well, it required a perfect PV panel. An age old panel could never meet the purpose. Hence it was more important to find the age and quality of the PV panel.

Few conventional and artificial intelligence methods to mitigate the events of power quality in PV grid tied systems. As a result, it was found that the AI techniques mitigated the PQ events of PV grid tied systems better than the conventional techniques. The DVR reduced 22 % of the voltage sag event. The AI techniques switched the operating methodology matching the surrounding conditions [11]. But those techniques required supervision and huge solid state memory. The algorithms were complex and took long learning time for the AI engine. The complexity got even worse when a damaged of years old PV panels. These panels injected more harmonics and could create more power quality issues in the grid. Hence the determination of the quality and age of the panel was highly significant is reducing power quality events. The future proceeding was to implement unsupervised AI learning with lesser memory requirement.

Three PV plants at Irbid, Amman, Aqaba located in the north, central and south of Jordan respectively were put to analysis. The PV module with 72 cells was chosen. The maximum output of the panel is 350W at 1000 W/m^2 irradiance and at 25^{o}C. The module temperature of the PV system at Aqaba measured highest among all and the irradiation at that place is also higher than other two locations [12]. Thus the PV system produced higher power at places where there was high irradiation. The selection of area was more important in implementing PV generation system. Even though we select the optimum installation place for a low quality PV panel, it was impossible to attain rated power output from the panels. Added to meet the power supply requirements of houses and industries, the PV panels were adopted to power flights. Since the fossil fuels polluted the atmosphere and limiting its usage in flights was another major leap. An unmanned solar powered vehicle was subjected to be analyzed about its performance. A plane was fabricated and the wigs were fitted with twenty-four mono crystalline PV panels to generate 12.4V. The cells were connected in series and required voltage was extracted and stored in 3S lithium polymer battery to power the plane. The area of the wings was chosen in such a way that the wings were not too lengthy. Energy, exergy and power conversion efficiency was calculated and average efficiency was derived from them. Exergy was the measure of energy quality whereas the energy was the measure of energy quantity [13]. When the temperature of the cell increased, it pulls down exergy and power conversion efficiency. Exergy was improved only by increased irradiation and lowered atmospheric temperature. Even all conditions were favorable; the faulty old panels could not meet the power requirement. So it was high need to determine the exact age and quality of the PV panel.

The performance and degradation analysis in PV panels was conducted with parameters such as performance ratio, yield energy, reference energy, capacity utilization factor, exergy and energy efficiency. The parameters said before was derived from the equivalent circuit and mathematical modeling of PV module. There were three variations of the equivalent circuit, such as one, two and three diode models. An ideal solar cell was recognized as a parallel combination of a current source and diode. Degradation methodology was carried out by the following methods. They were, visual inspection, I-V Characteristics, ultra sonic inspection, infrared imaging, electro luminescence imaging, and laser beam induced current [14]. These methods were more time consuming and required complex calculations, hence a simpler method of determining the quality and age of the panel was required to be implemented. Two solar power plants each with 5KWp capacity was selected for evaluation. Out of which one had Crystalline Silicon (c-Si) whereas the other plant had Copper Indium Selenium (CIS) panels. Both were connected to the grid. Annual data (for year 2014) contained various parameters like array yield, final yield, capacity factor and performance ratio. All were recorded under natural climate. From the collected data it was found that the CIS PV plant outperformed c-Si plant due to its high energy conversion efficiency. The economic viability is found to be 41% lesser than other PV systems. For such an economic efficient system, there was certainty of performance degradation as age increased. Hence by timely replacing the degraded system we could attain even more profit and performance from the system [15]. PV planner simulation software was utilized to simulate a 110 KW grid connected Photo Voltaic system for analyzing various PV technologies. The performance ratio of the amorphous silicon module was found to be optimum than other PV plants such as crystalline Silicon, Cadmium Telluride, and Copper Indium Selenide. The energy output of the amorphous silicon was higher than the rest of the plants [16].

In addition to the optimum performance of the PV plant, the determination of the age and quality of the plant was also significant with which the maintenance planning of the PV plants could be done for efficient operation of the PV system. For this a Hybrid Photovoltaic Thermal system was analyzed. It was used to heat water and air along with power production. The production of thermal energy by the system was utilized to heat air and water which could be used by appropriate applications. Two transparent parallel connected PV/T panel were implied. Along with this setup a double pass flat pat air collector and copper water tube was fabricated and a water collecting tank was fitted. Hottel Whillier Bliss equation was substituted with temperature data of solar cell, water and air for the purpose of estimating the system performance. It resulted that at 800W/m^2 irradiance, the hot air and water flowed at a rate of 0.05kg/s and 0.02 kg/s respectively with outlet temperature measuring 27.4^o C. The power output was 145W. Unlike other hybrid systems, it produced continuous power at the output without compensating power [17]. The power production was possible only when the good quality panel was installed. The performance analysis of a Luminescent Solar Concentrator module was conducted [18]. These LSC's were installed as windows, shading flaps and any such component that does not affect the transparency of the building. The LSC had semi transparent plate with PV cells fixed at the edges. They were self absorbing in nature and hence no photon was left to escape. This caused internal reflection and the output of such panel was good. Results confirmed that these LSC panels were better performer than the standard PV modules. A fuzzy logic based MPPT controlled was employed in a PV setup, for deriving higher power output from the PV system [19]. It required sound skill about the numerous fuzzy logic functions and subset rules. Only by frequent parameter tuning in the program, the desired output was obtained. Further development was focused conduct the same examination under various tilt angles, various climate and longer time duration. Numerous PV systems in northern Chile were analyzed for 16 months [20]. It was found that the value of the performance ratio was subjected to the level of dust settlement and atmospheric temperature. It was reported that the yield of energy was higher in summer and low in winter. Two varied technologies of PV system were compared under the same working conditions. It was found that the dust particles highly affected the performance rate of thin film PV systems than the mono-Si modules. High yield was achieved by the usage of mono –Si PV system than the rest other PV technologies. At cleaner conditions and at peak ambient temperatures, the thin film PV system performed better than the other technologies due to their special feature of negative temperature coefficient. Thus it was clear from the above analysis that the thin film PV systems were best suited for the winter conditions in which they gave PR values to rise from 55% to 80%. The mono-Si systems also had their PR rise from 64% to 82% which was less when compared to the rise achieved by the thin film PV systems. It was confirmed that the thin film PV systems gave improved performance when they were cleaned. But the Mono –Si PV systems did not require frequent cleaning because the improvement in the PR values were low when compared to the drastic improvement in thin film PV systems.

The performance of three different grid connected PV system such as poly-Si, a-Si, CdTe located at Madrid were compared for the period of three years [21]. The parameters took for comparison was STC deviation, capture loss, yield loss, and air mass dependence. It was found that the STC performances decreased over the period of analysis. The capture losses varied for all the PV systems. Lower negative capture loses were recorder for the poly-Si and CdTe systems in winter. But in summer season it was high due to the added clipping effect of inverter. The performance ratio of the PV systems was observed to be in the range of 80% and 81% and their inverter conversion efficiencies ranged between 89% and 90%. It was not abnormal and it was considered to be normal operation of all the PV systems. The air mass dependence was another significant factor. The PV output was deviated by the rise in temperature but it was compensated by the thermal annealing effect and the light soaking effect. The analysis revealed that minor deviations from STC were observed in all the systems. However all the positive outcome was made possible only with a brand new and good quality PV panels. If that was not suitably checked then the desired output could not be attained. Hence these studies motivated for the estimation of the PV panel quality and age, which is in need of attention.

II. DESCRIPTION OF THE SYSTEM

Solar Photovoltaic panels are becoming popular as part of renewable energy awareness among the public and industries. Many institutions started to install such PV system at their campus to be self sufficient and also as promotional activist of renewable energy. Along with these types of self involvement activities of organizations, some private concerns aid the installations by referring some of their PV products for profit. Not all PV panels are of premium quality. Most of the panels are manufactured without following the international standards. The qualities of such panels are always questionable that they could not meet the panel board ratings. Hence the proposed work furnishes an algorithm to find out the age and quality of the PV panel before purchasing it and also the same methodology is useful to monitor the quality of the panel in the mid of the year as a part of maintenance activity. Thus a panel can be frequently examined and proper decision can be taken whether or not to replace them. We can get a clear picture of investment planning in such PV installations since the proposed method gives data about the life time of any PV panel on how many years or days that the installed PV panels will deliver quality power under the present operating conditions. From the proposed method, the health status of any PV panel can be found out with the following parameters. They are,

(i) Open Circuit Voltage (V_{OC})
(ii) Short Circuit Current (I_{SC})
(iii) Maximum Power (P_{Max})
(iv) Maximum Output Power Voltage (V_{MP})
(v) Maximum Output Current (I_{MP})
(vi) Fill Factor
(vii) Temperature
(viii) Irradiation level
(ix) Efficiency

The proposed method also includes finding of the panel quality. The quality of the panel includes

(a) Cell Quality
(b) String Quality
(c) Glass Quality
(d) TPT Material

Upon testing the quality level of the PV panels, grade points are assigned to them according to the classification given in the below table1.

TABLE I. PV PANEL QUALITY RANGE

Normal	Mild	High	Very High
0 – 25	25 – 50	50 – 75	75 - 100

While calculating the quality of the panel we set the constant degradation rate of a panel as 0.8% per year. The power deviation finding is another important part of the proposed work. For this we examine some of the thermal images of the PV panel taken with a thermal camera. An algorithm is created to find the IRTI value from the thermal image. MATLAB simulation is executed to calculate the power deviation and from that the defect percentage and the age of the panel is estimated. The block diagram of the proposed work is given in fig.2. NOCT and STC are the two input data for the test center which manipulates the data by executing the algorithms programmed in it. The I_{SC} and V_{OC} values of the PV panel under examination are gathered from their panel plate and they are the STC condition values. Whereas for the NOCT data we gather the atmospheric temperature, irradiation level, I_{SC} and V_{OC} values. As shown in the fig.4 the test center derives the values of efficiency, IRTI, overall quality and power deviation.

A. Normal Operating Cell Temperature (NOCT)

It is the testing standard derived for the operating conditions of a solar cell. It is defined as the temperature attained by open circuited cells in a module.

B. Standard Test Condtion (STC)

The standard test conditions are defined as the solar irradiation of 1KW/square meter module temperature of 25ºC and a solar irradiation angle of 45º.

C. IRTI

Infra Red Thermal Imagery is the image capture by the thermal camera. The IRTI produces accurate images revealing the hotspots and any possible defects in the area of inspection. These images are fed to the test centre. Image processing is done on these thermal images and an IRTI value is derived from it.

D. Thermal Imaging Camera

The thermal imaging camera is a device that captures thermal images of any object without any physical contact. In thermal imaging, the infrared radiations emitted by any object are converted into a different colour pattern of thermal images known as Thermogram. Thermal imaging can be used in monitoring as well as maintenance areas like detection of hot spots, failures, cracks, in solar panels, overheating problems in mechanical installations heating, leakage and insulation breakdown in pipes and valves etc. The FLIR E4 Thermal imaging camera that is used in this proposed work is given in fig.1 and the technical specifications are mentioned in table. 2

Fig.1. FLIR E4 Thermal Imaging Camera

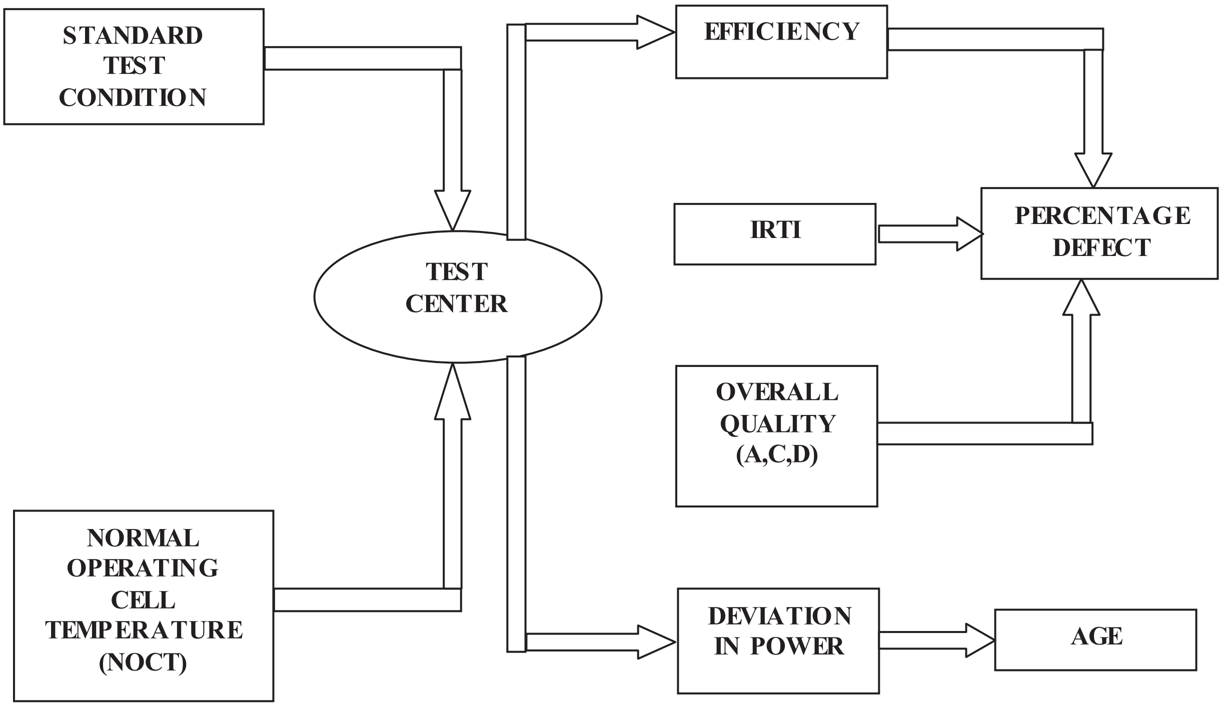


Fig.2. Block diagram of the proposed work

TABLE 2. TECHNICAL SPECIFICATIONS OF THE FLIR E4 THERMAL CAMERA

Thermal Camera Info	Value
Type of Detector	Uncooled micro bolometer
Min. Focus distance	0.5m (1.6 ft)
Spectral range	7.5 - 13µm
Environment operating Temp.	-15 °C to 50° C(5ºF to 122ºF)
Environment humidity	≤ 90 % Non-condensing
Accuracy	±2ºC
Thermal sensitivity	≤ 0.15ºC (0.27ºF0/<150 mK
Color palette	Black & white, iron, and rainbow

E. Pyranometer

A Pyranometer is a type of actinometer used for measuring solar irradiance on a planar surface and it is designed to measure the solar radiation flux density (W/m^2) from the hemisphere above within a wavelength range 0.3 µm to 3 µm. The picture of the Pyranometer that is used in the work is given in fig. 3a and 3b

F. Clampmeter

A clamp meter is an electrical test tool that combines a basic digital multimeter with a current sensor. The clamp measures current while the probes measure voltage. Having a hinged jaw integrated into an electrical meter allows technicians to clamp the jaws around a wire, cable or other conductor at any point in an electrical system, then measure the current in that circuit without disconnecting or de-energizing it. The clampmeter is shown in Fig.4.

Fig.3a. Pyranometer

Fig.3b. Pyranometer in practical usage

Fig.4. Clamp meter

G. Normal Test Operating Conditon (NTOC)

It is a testing standard geared to the operational conditions of solar cells, defined as the temperature reached by open circuited cells in a module assuming 800W/ m² irradiance, 20°C ambient temperature and wind speed of 1m/ s with the tilt angle of the PV module set to 45°. The back side is open to the surrounding air (as opposed to conditions where panels are mounted on roofs and heat builds up under the panel).Similar to PTC, NTOC conditions are an approach to mimic the real world setup. It is useful to calculate the real available wattage on an average day and is comparatively stricter parameter that is required by a range of energy rating and output performance standards. It is the major testing condition alternative to Standard Testing Conditions (STC) and also used for solar panel performance quality testing during mass production.

The flow chart for finding the IRTI value is given in fig.6 and the Matlab program is given in program 1. The flowchart for finding the age, overall quality of the panel, percentage defect is given in fig.7 and the corresponding Matlab program is given in program 2. The outputs of the test centre are Efficiency, Irradiation of Thermal Imaging (IRTI), Overall Quality and deviation in power. By analysing efficiency, IRTI and Overall quality, Percentage Defect is calculated. By measuring deviation in power, Age of the solar panel is found out. The formulas used to find the above values are furnished below.

H. Percentage Quality of the PV Panels

$$\text{Percentage Quality} = (100 - \text{Percentage Defect}) * 100 \quad (1)$$

Whereas the Percentage Defect is found out by executing the formula equation (2) given below

I. Percentage Defect of the PV Panels

$$\text{Percentage Defect} = \left\{1 - \left[\frac{\text{Percentage Efficiency in Actual}}{\text{Percentage Efficiency in Ideal}}\right] * \frac{((4 * \text{IRTI}) + A + B + C + D)}{(8 * 100)}\right\} \quad (2)$$

J. Percentage Deviation of Power in PV Panels

$$\text{Perecentage Deviation} = \frac{\text{Deviation in Power}}{\text{Ideal Power}} \quad (3)$$

$$\text{Deviation in Power} = \text{Percentage Ideal Power} - \text{Percentage Actual Power @ } 1000\ \text{W/m}^2 \quad (4)$$

K. Age of PV Panel

$$\text{Age} = \frac{\text{Percentage Deviation}}{0.8} \quad \text{Years Old} \quad (5)$$

Hence from the above equations it is clear that from Percent Deviation of equation (4) we can calculate Percentage Defect (3) and Age of the Panel (5).

A polycrystalline panel is taken for analysis. The panel specifications are given in table.3 and the fig.5 shows the physical structure of a Polycrystalline PV panel

Fig.5. Polycrystalline PV Panel

TABLE .3. POLYCRYSTALLINE PV PANEL SPECIFICATIONS

Panel Specification of Polycrystalline PV panel	
Peak Power P_{max}	10 W
Max Power Voltage (V_{MP})	18.25 V
Max Power Current (I_{MP})	0.55 A
Open Circuit Voltage (V_{OC})	21.96 V
Short Circuit Current (I_{SC})	0.59A
Panel Quality	100 %
Percentage Defect	0.8 % per Year
Efficiency	16 %
Age	0 Year

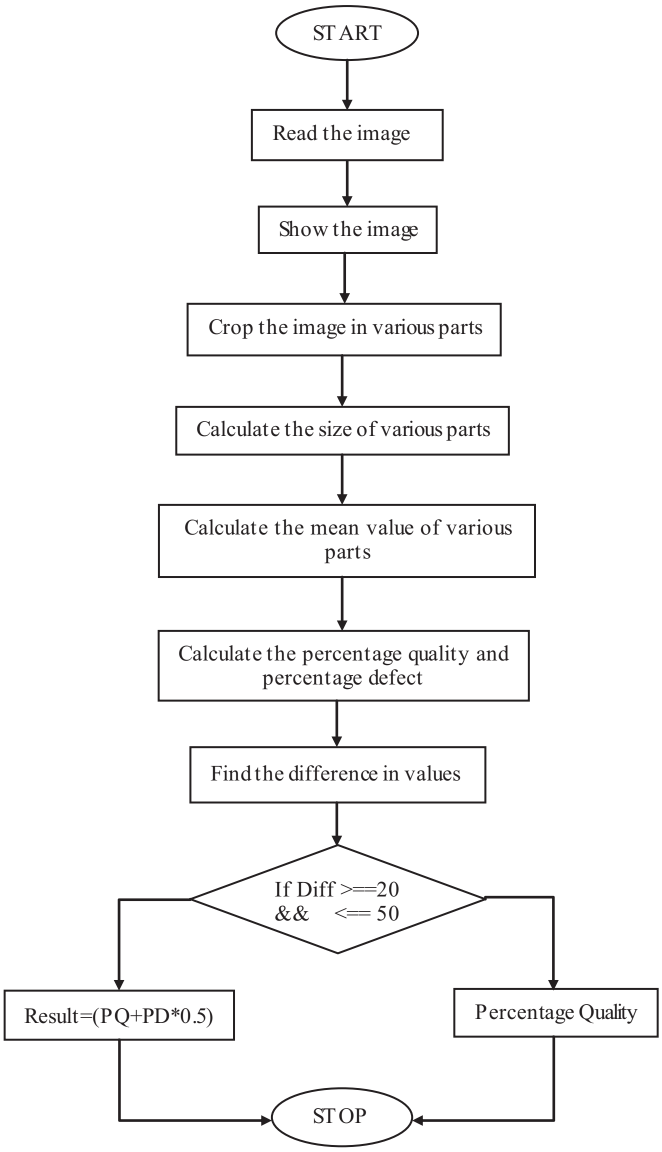


Fig.6.Flow chart to find the IRTI Value

Program 1: Matlab Program to find the IRTI value

```
clc
clearall;
closeall;
src=imread('C:\Users\LENOVO\Pictures\percentage defact panel\panel40.jpg');
imshow(src);
M=rgb2gray(src);imshow(M)
mas1=imcrop(M);imshow(mas1);
[a1 b1]=size(mas1);
c1=a1*b1;
mas2=imcrop(M);imshow(mas2);
[a2 b2]=size(mas2);
c2=a2*b2;
mas3=imcrop(M);imshow(mas3);
[a3 b3]=size(mas3);
c3=a3*b3;
m1=mean2(mas1)
m2=mean2(mas2)
m3=mean2(mas3)
m11=((c3-c1)/c3)*100
m22=((c3-c2)/c3)*100
PD=m11
PQ=(100-m11)
DIFF=m1-m2
if DIFF>=20  && DIFF<=50
result=(PQ+(PD*0.5))
else
 result1=PQ
end
```

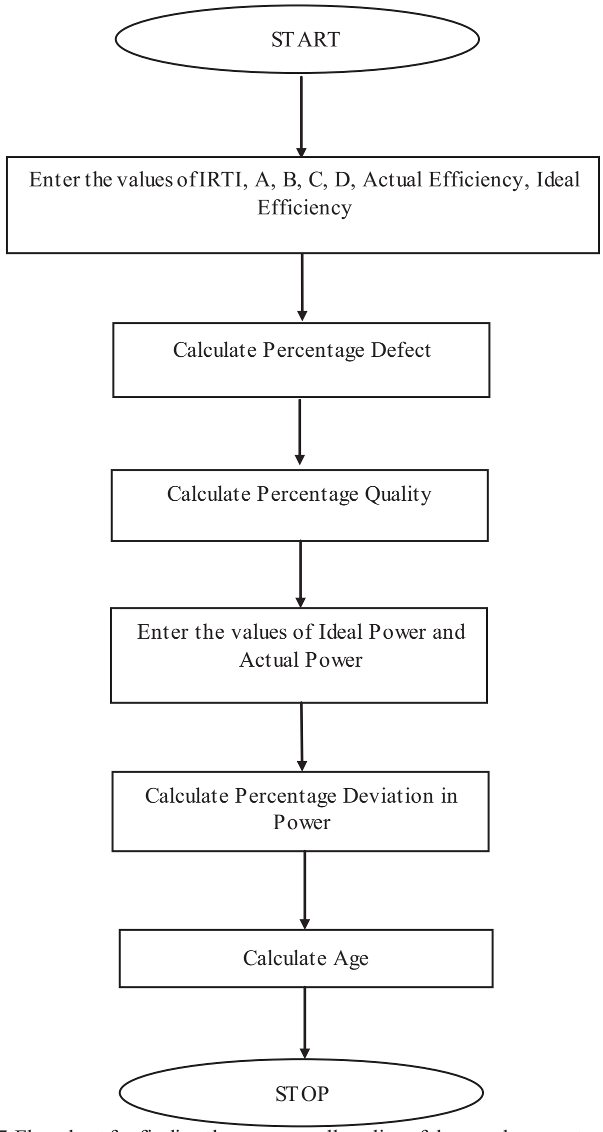


Fig.7.Flowchart for finding the age, overall quality of the panel, percentage defect

Program 2: Matlab program to find the age, overall quality of the panel, percentage defect

```
Clc
clearall;
actualefficiency=input('enter the value of actual efficiency');
idealefficiency=input('enter the value of ideal efficiency');
IRTI=input('enter the value of IRTI');
A=input('enter the value of A');
B=input('enter the value of B');
C=input('enter the value of C');
D=input('enter the value of D');
sum1=actualefficiency/idealefficiency
sum2=(((4*IRTI)+A+B+C+D)/(8*100))
percentagedefect=(1-(sum1*sum2))*100
percentagequality=(100-percentagedefect);
idealpower=input('enter the value of ideal power');
actualpower=input('enter the value of actual power');
deviation = (idealpower - actualpower)*100d
percentagedeviationinpower=(deviation/idealpower)
age=percentagedeviationinpower/0.8
```

III. Result and Discussion

The STC and NTOC for seven polycarbonate PV panels are tested and then those values are compared with the original specifications of the panels. With this comparison we can find out the overall quality of the panel, percentage defect and age of the panel. The STC testing condition setup is given in fig.8 and the data for STC setup is furnished in table 5 and the comparison is given in table 4.

The continuous irradiation of 1000 W/m^2 at actual working conditions is not attainable. Hence to take STC data we use two 1000 watt halogen lamps for illuminating the panels equally. The maximum power that is attained with this irradiance is 9.34 W as the highest STC level. This is delivered by panel 4 and 5.55 W to be its lowest STC level which is delivered by panel 5. The panel 4 has efficiency of 15.6% and panel 5 is 9.27%. But the rated panel efficiency is 16% which is only 0.4% higher than that achieved by panel 4. Panel 5 is 6.73 % less efficient than that of the original panel rating. Hence it is found that among the 7 polycrystalline PV panels that were under examination, panel 4 delivers higher power and panel 5 delivers the least among all. The age of the best panel i.e. panel 4 is found as 1 year old and that of panel 5 is 5 years old. Hence it is finalized that the panel 4 is new and is of very high quality.

Now the NTOC data has to be taken and for this operating state the panel quality and age has to be identified. The setup for the NTOC analysis is shown in fig.9 and the thermal images that are captured using the thermal camera is show in fig. 10(a) to 10(g). The NTOC condition analysis data is given in table 6. The comparison between the original and the NTOC condition is furnished in table 7.

Here at Normal Test Operating Conditions, all the panels are let independently to get irradiated by the natural sun light. Hence all the panels are unevenly irradiated and the panel 6 delivers 7.41W with the incident irradiation of 995 W/m^2. Even though panel 3 receives irradiances of 995 W/m^2 it can deliver only 3.09 W which is the lowest NTOC level of all. The analysis ended up revealing that the panel 3 is only 5.44% efficient and is 78% defective. Hence it delivered the lower power output. On the other hand panel 6 that delivered the highest power is 3 years old panel with 37% defect and the quality is 62% and 12.44% efficient which is on the safer side of operation. All the other panels fall between the ages of 3 to 8 years. The panel 6 is graded to be high quality

Fig.8. STC Testing Setup

Fig.9. NTOC Test Setup

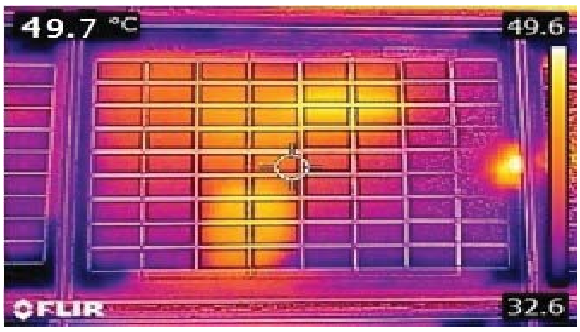


Fig.10a. Panel 1

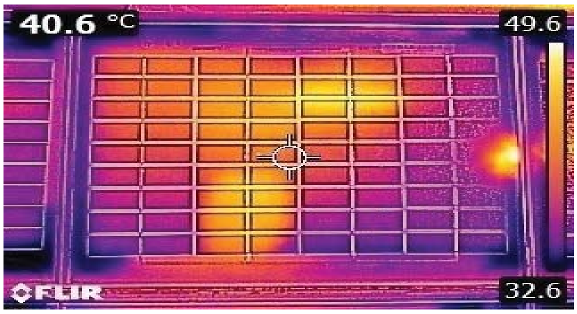


Fig.10b. Panel 2

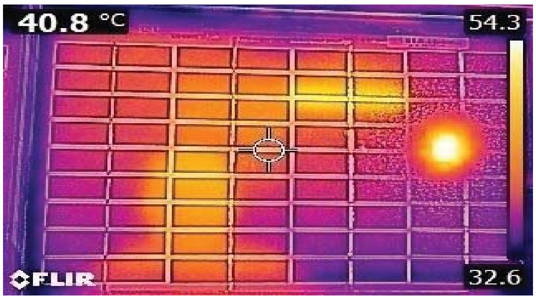


Fig.10c. Panel 3

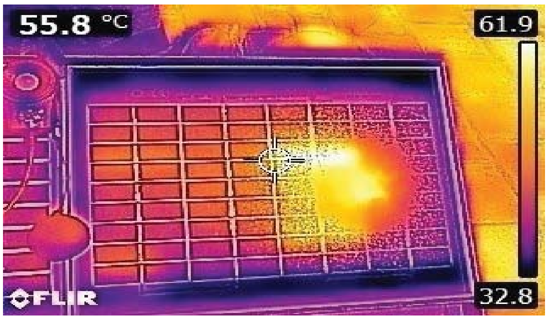


Fig.10d. Panel 4

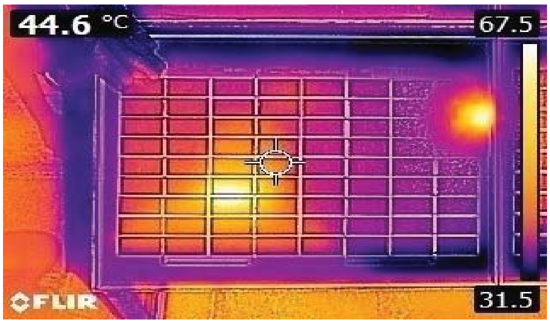
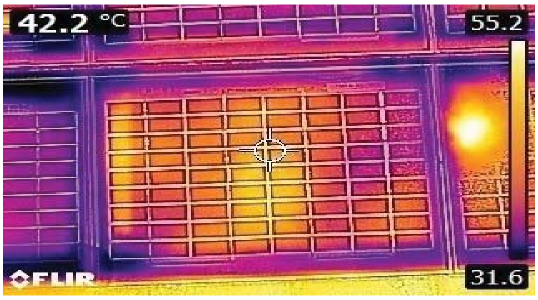


Fig.10e. Panel 5



Fig,10f. Panel 6

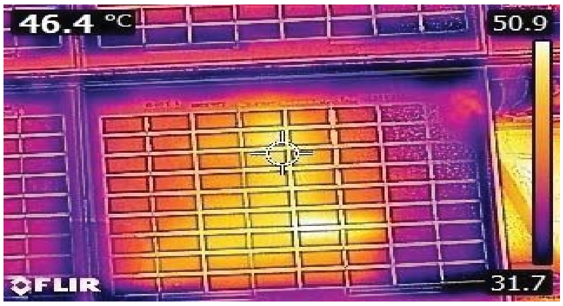


Fig.10g. Panel 7

TABLE.4. COMPARISON CHART FOR ORIGINAL AND STC CONDITION

Parameters	**Original Panel Specifications**	**High STC Condition**	**Low STC Condition**
Maximum Power	10	9.34	5.55
Panel Quality (%)	100	99.22	95
Percentage Defect	0.8% per year	0.8% per year	4%
Efficiency (%)	16%	15.6%	9.27%
Age	-	1	5

TABLE.5. STC PRACTICAL DATA

Panel	**Irradiation (W/M^2)**	**Temperature (^OC)**	**Open Circuit Voltage (V_{OC})**	**Short Circuit Current (I_{SC})**	**Maximum Power Output Voltage (V_{MP})**	**Maximum Power Output Current (I_{MP})**	**Maximum Power (W)**	**Efficiency (%)**
Panel 1	1000	25	19.08	0.76	14.61	0.58	9.04	15.11
Panel 2	1000	25	19.08	0.4	14.69	0.3	6.75	11.27
Panel 3	1000	25	18.85	0.55	14.68	0.42	7.41	12.38
Panel 4	1000	25	19.17	0.43	14.57	0.33	9.34	15.6
Panel 5	1000	25	19.01	0.26	14.63	0.2	5.56	9.28
Panel 6	1000	25	19.07	0.25	14.68	0.19	5.55	9.27
Panel 7	1000	25	18.88	0.19	14.54	0.14	5.97	10.2

TABLE.6 NTOC ANALYSIS DATA

Panel	**Irradiation W/m^2**	**Short Circuit Current (I_{SC})**	**Open Circuit Voltage (V_{OC})**	**Max Power Voltage (V_{MP})**	**Max Power Current (I_{MP})**	**Max Power (W)**	**Efficiency (%)**	**Temperature (^oC)**	**Fill Factor**
Panel 1	940	0.4	20.5	15.78	0.24	3.77	6.7	49.7	0.46
Panel 2	940	0.58	20.59	15.85	0.44	6.92	12.3	40.6	0.58
Panel 3	950	0.26	20.22	15.56	0.20	3.09	5.44	40.8	0.59
Panel 4	979	0.52	20.27	15.61	0.40	6.21	10.6	55.8	0.59
Panel 5	923	0.37	20.2	15.55	0.28	4.33	7.83	44.6	0.58
Panel 6	995	0.62	20.6	15.86	0.47	7.41	12.44	42.2	0.58
Panel 7	1008	0.44	20.47	15.35	0.33	6.75	11.18	56.4	0.58

TABLE. 7 COMPARISON CHART BETWEEN ORIGINAL AND NTOC CONDITION

Parameters	Original Panel Specifications	High NTOC Condition	Low NTOC Condition
Maximum Power	10	7.41	3.09
IRTI Value	-	82.45	51.81
Panel Quality (%)	100%	62%	22%
Percentage Defect	0.8% per year	37%	78%
Efficiency (%)	16%	12.44%	5.44%
Age	-	3	8

IV. CONCLUSION

The estimation of the age and quality of Solar photovoltaic panels are executed by efficiently implementing the techniques and there by aiding to the growth of the emerging renewable energy systems. The present age and quality of the PV panels under usage are estimated by the proposed work. By the proposed technique, any degradation of the panels is identified at any instant of observation. Thus the proposal of Quality Span Prediction (QSP) of solar photovoltaic panels can be used as a quality assurance method to achieve efficient results. This work can be used to any type of areas like house hold applications, Power plant testing, and in rural areas of installations. The method is cheaper to execute and effective in results which can be relied very much upon. From the results obtained, it is clear that the fault identification and age estimation is made simpler and accurate.

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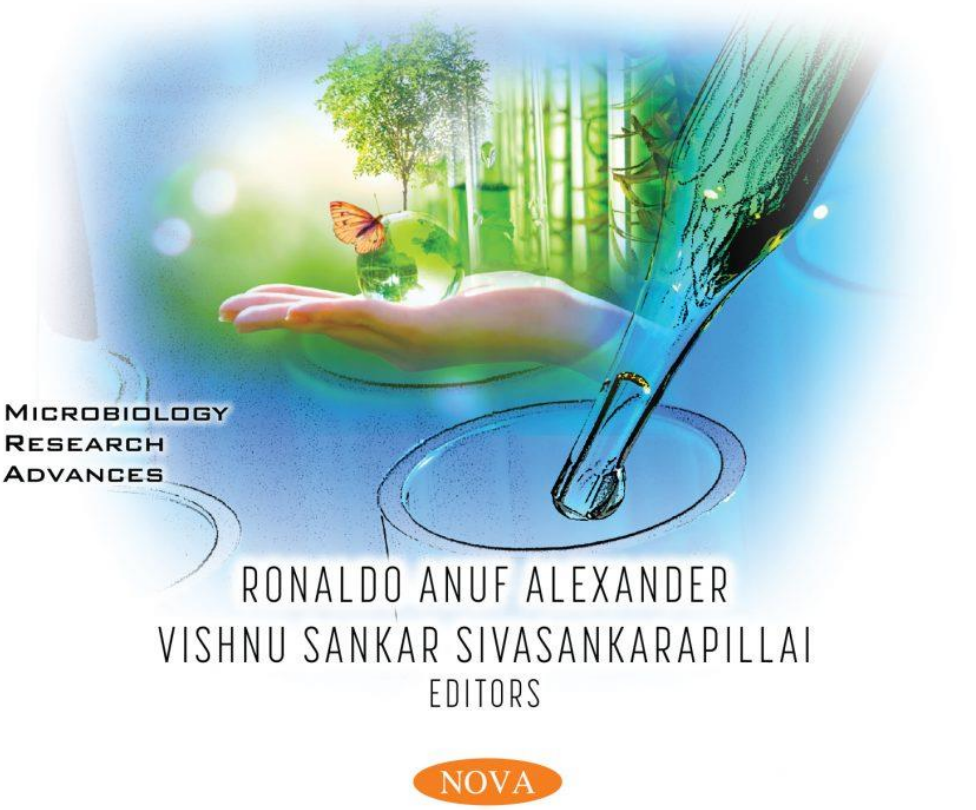

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Material and Process Selection for Biosorption

Karl J. Samuel P N, Michael Rahul Soosai, I. Ganesh Moorthy, and Karthikumar Sankar

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Abstract Pollution in all the essential elements such as air, water and land is a serious environmental problem for the last few decades. Among various methods for

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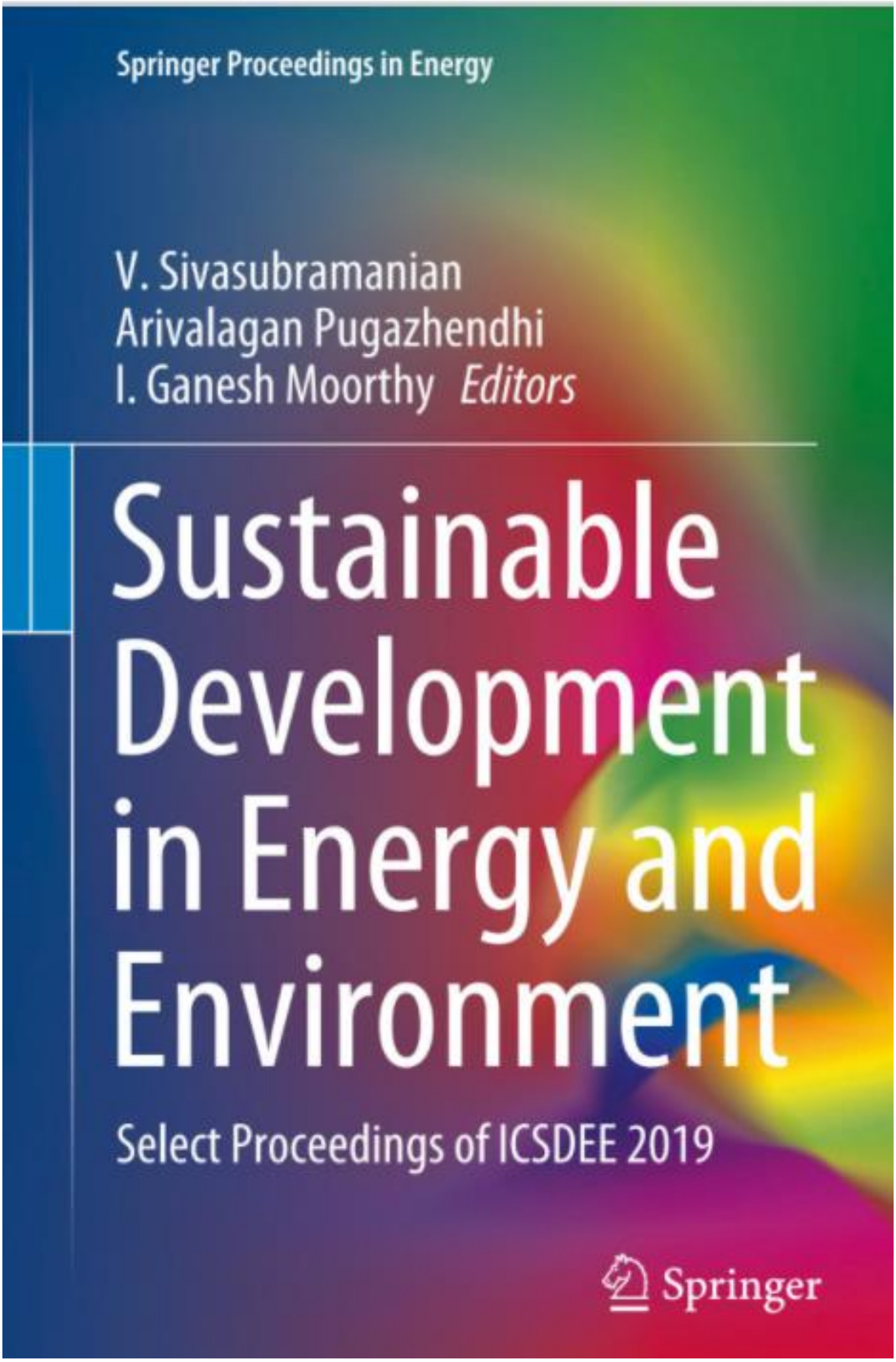
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Continuous Sorption of Chlorpyrifos from Aqueous Solution Using Endoskeleton Powder of *Sepia officinalis*

Karthikumar Sankar, Shyam Kumar Rajaram, I. Ganesh Moorthy, K. Naresh, S. Vaitheeswaran, R. K. Akash Kumar, G. R. Murary Viyas, and P. N. Karl J. Samuel

1 Introduction

Pesticides play a vital role in agriculture where the global rise in food demand is tackled. According to the record of India central statistics, 15–25% of the potential crop production is lost due to various pests and diseases. Use of pesticide can increase crop productivity by 25–50%. Hence, pesticides are very essential to ensure food security [1]. Although, pesticides cause various deleterious effects to the animals and humans; total restriction to usage of pesticides momentarily is impractical. In global pesticide production, India is ranked fourth place after the USA, Japan and China [1]. Chlorpyrifos ((*O*,*O*-Diethyl *O*-3,5,6-trichloropyridin-2-yl phosphorothioate) is one of the organophosphate pesticides, which is commonly used for variety of crops. Chlorpyrifos controls wide range of pests including mosquitos, cockroach, cutworms, termites, flies, lice, beetles and corn rootworms [2]. In humans, chlorpyrifos poisoning involves competitive inhibition of carboxylic ester hydrolases mainly acetylcholinesterase (Ache) which results neuronal disorders. It also causes oxidative stress and endocrine disruption [3]. The lipid solubility and half-life of the chlorpyrifos in the human body is increased by chlorine moiety in the structure [3]. The active site of the neuropathy target esterase is also blocked by chlorpyrifos which results in loss of function of myelin and axon fibers of peripheral and central nerves system [4].

The human health risk of chlorpyrifos calls for creative and effective novel solutions to tackle the problem. Bio-sorption using nanoparticles [5–7], electrochemically assisted remediation and advanced oxidation processes [8, 9] are considered as excellent process of pesticide elimination from water bodies [10]. However, the

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Bioprocess Engineering for Bioremediation

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Membrane Technology in Bioprocess Engineering

Randeep Singh, K. V. V. Satyannarayana, R. Vinoth Kumar, and I. Ganesh Moorthy

Contents

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Chapter

Biopolymers as a Sustainable Approach for Wastewater Treatment

By J. Juliana, K. L. Jesintha, S. Mariaamalraj, V. C. Padmanaban, A. R. Neelakandan, G. K. Rajanikant

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ABSTRACT

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An Improved Monkey Search Algorithm to Solve the Flexible Job Shop Scheduling Problems With Makespan Objective

Mariappan Kadarkarainadar Marichelvam
Mepco Schlenk Engineering College, India

Geetha M.
Kamaraj College of Engineering and Technology, India

INTRODUCTION

Scheduling is a vital decision making processes in both manufacturing and service industries. The main objective of scheduling is to allocate the available limited resources to perform a group of tasks over a period of time to optimize some performance measures. The most important performance measures are minimization of makespan, flow time, tardiness, and lateness. A wide variety of scheduling problems were addressed by the researchers. Among them flexible job shop scheduling problem (FJSP) is considered in this paper due to its theoretical and practical significance. The FJSP is an extension of the classical job-shop scheduling problem (JSP). In the classical JSP, *n* jobs are to be processed on *m* machines and it is assumed that the *n* jobs have pre-determined sequences of operations and also each operation is performed on a predefined machine. In the FJSP, the operations are processed on the multiple capable machines. The FJSP is formed by assigning each operation to a machine out of a set of capable machines and sequencing the assigned operations on each machine to obtain a feasible schedule by considering a predefined objective function. The FJSP were proved to be non-deterministic polynomial-time hard (NP-hard) type combinatorial optimization problems (Garey et al., 1976). Hence, with the increase in problem size, the computational time would also increase. Therefore, the exact algorithms such as branch and bound, branch and cut, Lagrangian relaxation and dynamic programming cannot be used to solve the large size problem instances. To overcome this difficulty, researchers have developed many heuristics. However, heuristics are based on a specified thumb rule for a particular problem. Hence, many meta-heuristic algorithms are addressed in the literature. Monkey search algorithm (MSA) is one of the recently developed meta-heuristic algorithms. In this paper, an improved MSA (IMSA) is considered to solve the FJSP with makespan objective function. The main objective of the work is to develop an improved monkey search algorithm (IMSA) for solving the flexible job shop scheduling problems for minimizing makespan and validate the performance of the proposed IMSA using the benchmark problems addressed in the literature. The background of the proposed research work is presented in the next section.

BACKGROUND

In this section the literature review on the FJSP, monkey search algorithm and variable neighbourhood search algorithm are present.

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FLEXIBLE JOB SHOP SCHEDULING

The FJSP was first addressed by Brucker and Schile, 1990. They developed a polynomial algorithm to solve the FJSP with two jobs. They also proposed hierarchical approaches and integrated approaches to solve the FJSP with many jobs. However, the exact algorithms could be used to solve only smaller problem instances. The real problems are larger in nature and hence they cannot be solved by the exact algorithms. A new neighbourhood structure was proposed by Dauzère-Pérès and Paulli (1997) to solve the FJSP. The TS algorithm was suggested by them for re-sequencing and rearranging the operation. Zhang and Gen (2005) proposed a multistage operation based GA to deal with the FJSP. Gao et al. (2006) presented a General Particle Swarm Optimization (GPSO) algorithm for solving FJSP. In the proposed GPSO, crossover and mutation operations in the Genetic Algorithm were incorporated to exchange the information and search randomly. In addition, the Tabu Search (TS) was also used for the local search. The performance of the proposed algorithm was demonstrated with the benchmark problems.

Fattahi et al. (2007) developed a mathematical model and heuristic procedures to solve the FJSP. Tabu search (TS) and simulated annealing (SA) are the heuristics proposed by them. They also addressed six different algorithms to solve the FJSP. They considered both integrated and hierarchical approaches in their research. Gao et al. (2008) proposed a hybrid GA and variable neighbourhood descent (HGVND) algorithm to solve the FJSP. Two local search procedures were introduced by them. The proposed algorithm was tested on 181 benchmark problems and the effectiveness of the algorithm was proved. Pezzella et al. (2008) presented a GA to solve the FJSP by developing different strategies to generate the initial population, selection and reproduction. They compared the results, with other GAs and TS algorithms.

Bagheri et al. (2010) introduced an artificial immune system (AIS) algorithm to solve the FJSP to minimize the makespan. In the AIS, Different strategies were developed to produce the initial population and selecting the individuals for reproduction. Different mutation operators were utilized for reproducing new individuals. Xing et al. (2010) addressed a knowledge-based ant colony optimization (KBACO) algorithm to solve the FJSP. In the KBACO, the knowledge model learned some available knowledge from the optimization of ACO. The existing knowledge is then applied to guide the current heuristic searching. Yazdani et al. (2010) solved the FJSP by a parallel variable neighbourhood search (PVNS) algorithm to solve the FJSP. The proposed method increased the diversification and the exploration in the search space. Al-Hinai and ElMekkawy (2011) introduced a hybrid GA (HGA) to solve the FJSP. The initial population generation algorithm and a local search method were combined in the HGA and hence the performance of the GA was improved. The proposed HGA outperformed other versions of GA.

Yuan and Xu (2013) presented two algorithms for solving the FJSP with makespan criterion. Hybrid harmony search (HHS) and large neighborhood search (LNS) are the two algorithms. In the HHS, a local search procedure was carried out to improve the solution quality. The proposed algorithms were used to obtain the new upper bounds for the benchmark instances. A teaching–learning based optimization (TLBO) algorithm was proposed by Baykasoğlu et al. (2014) to solve the job shop scheduling problems. González et al. (2015) addressed the scatter search (SS) algorithm combined with path re-linking and TS for solving the FJSP with makespan objective. They compared the performance of the proposed algorithm with several other algorithms addressed in this literature for standard benchmark problems. A biogeography based optimization (BBO) algorithm with some heuristics was proposed by Lin (2015) for solving the FJSP. He also introduced a path re-linking technique, an insertion-based local search heuristic and an efficient machine assignment rule. Cinar et al. (2016) developed a priority-based genetic algorithm (PBGA) for solving the FJSP. In the proposed algorithm, the priority of each operation was represented by a gene on the chromosome. Iterated local search (ILS) was applied to the chromosomes at

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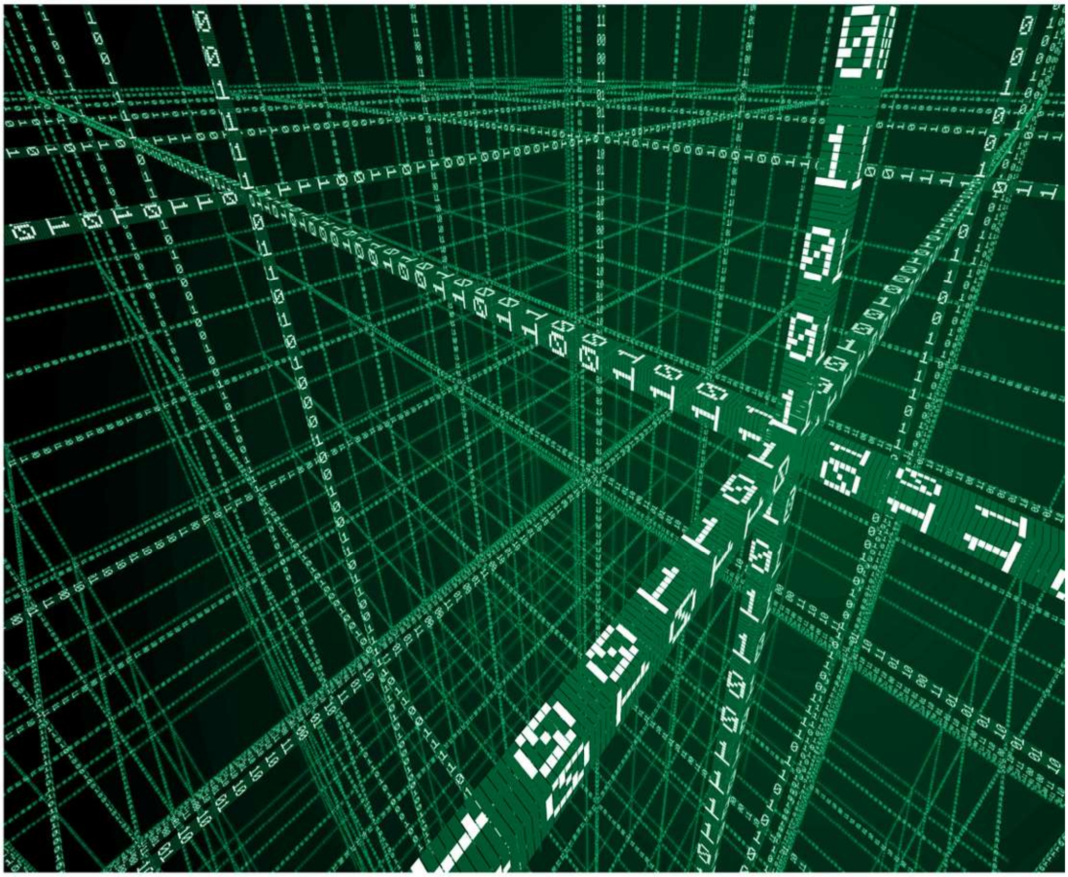

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Chapter 4

Efficient ciphertext-policy attribute-based signcryption for secure big data storage in cloud

Praveen Kumar Premkamal[1,2,3], Syam Kumar Pasupuleti[2] and Alphonse PJA[1]

Due to the huge volume and complexity of big data, outsourcing big data to a cloud is the best option for data storage and access, because the cloud has the capabilities of storing and processing of big data. However, data privacy, access control, and authentication are significant concerns for big data because the cloud cannot be fully trusted. Ciphertext-policy attribute-based signcryption (CP-ABSC) has been an effective cryptographic technique to provide privacy, access control, and authenticity in the cloud environment. However, the following two main issues of CP-ABSC that limits CP-ABSC scheme to deploy for big data in the cloud: (1) suffer from higher computation overheads during signcryption and designcryption and (2) CP-ABSC provides unlimited time data access rights as long as attributes satisfy the access policy which restricts to apply for commercial big data applications. This chapter proposes an efficient ciphertext-policy attribute-based signcryption (ECP-ABSC) for big data storage in cloud to address the previous two issues. ECP-ABSC scheme reduces the required number of exponentiation operations during signcryption and outsources the inflated pairing computation during the designcryption process, which, in turn, reduces the computation overhead of data owner and user. Our scheme also provides flexible access control by giving data access rights to unlimited times or a fixed number of times based on the user. This flexible access control feature increases the applicability in commercial applications. Further, we prove the desired security requirements of our scheme that include data confidentiality, signcryptor privacy, and unforgeability in security analysis. The feasibility and practicality of our scheme are provided in performance evaluation.

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22 | OriginalPaper | Chapter

Blockchain-Powered Healthcare Information Exchange Systems to Support Various Stakeholders

Authors: R. Ramya, A. Anandh, K. Muthulakshmi, S. Janani, N. Gayathri

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Abstract

Initially, blockchain technology was emerged for the enhancement of financial transactions, as it is independent of the need to have any third party to verify the transactions. Progressively, it has been slightly modified based on the different application-specific requirements such as data security and privacy. One of the emerging applications of blockchain is E-healthcare that concerns mainly about integrity, authenticity, and consistency of patients' medical records. Due to the evolution of Internet of Things (IoT), a lot of healthcare data is being produced through the use of various devices like smart watches, smart sphygmomanometer, smart thermometer, etc. This imposes the need to concern about scalability along with interoperability. A novel architecture to handle the electronic medical records (EMR) of the patients by various medical entities is proposed. As large amounts of records are to be handled, the healthcare archives are kept in the cloud for streamlining the usage of information among diverse stakeholders. Also, there is a provision to enable the measures that handle security and privacy in the cloud architecture. Suitable public key cryptography and hashing methods are exploited to maintain the past transactions corresponding to the patients' records. This preserves confidentiality, integrity, and availability. It also prevents the modification or falsification of data by unauthorized persons. Using blockchains, patients' records can be added only at the end of the database, but they cannot be removed. New records are securely connected to the preceding record using cryptographic hashing. Special node called data validator is used to check the quality and authenticity of user-uploaded data, from which the records can be examined and patient health status reports are prepared. Again, encryption and digital signing are performed on the data to store it back to the blockchain. This proposed system ensures that no individual can modify or damage the verified records that are already stored. Our proposed novel architecture was tested against MIT-BIH Arrhythmia Database, and the stated functionality requirements are met.

Garbage Detection Using Deep Learning Techniques

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Abstract

Object detection is a central task in computer vision, with applications ranging across the process of smart city construction, city managers always spend a lot of energy and money cleaning street garbage due to the random appearances of street garbage, As deep network solutions become deeper and more complex, they are often limited by the amount of training data available. With this in mind, to spur advances in analyzing and understanding images, Open CV or Google AI has publicly released the Open Images dataset. Open Images follows the tradition of PASCAL VOC, Image Net and COCO, now at an unprecedented scale. In this project we to implement the Consequently, visual street cleanliness assessment is particularly important. However, existing assessment approaches have some clear disadvantages, such as the collection of street garbage information is not automated, and street cleanliness information is not real-time best performing algorithm for automatically detecting objects. Finally, the results are incorporated into the street cleanliness calculation framework to ultimately visualize street cleanliness levels, which provides convenience for city manager.

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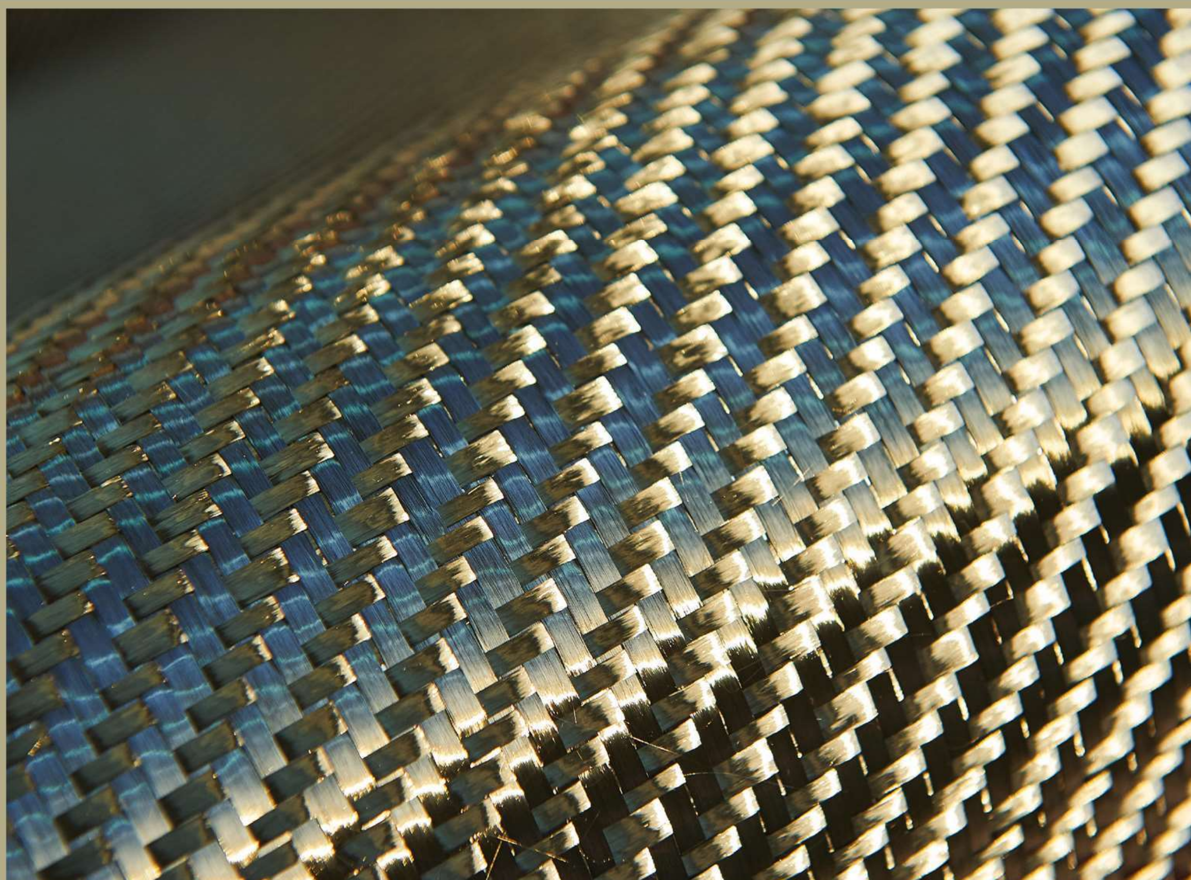

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MATERIAL FORMULATIONS, PROCESSING, CHARACTERIZATION, PROPERTIES AND ENGINEERING APPLICATIONS

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CHAPTER TEN

A review on the factors influencing natural fiber composite materials

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10.1 Introduction

Composite material is a combination of two or more different materials that are chemically, structurally and physically different from each other. Since the composite material is a combination of two materials, the weakness of one material will be compensated by other material. Composite materials consist of two phases namely matrix and reinforcement. Matrix is generally responsible for bonding of reinforcements, whereas the duty of reinforcement is to transfer load. Third phase of composite material is known as fillers which may bring modifications in properties of composite materials. Fillers like rice husk, silica, graphite, and many others are generally used with composite materials [1]. Composite materials are broadly classified as synthetic and natural fiber reinforced composite (NFC) materials. NFCs are being used as a potential replacement for man-made synthetic fibers like aramid, glass, and carbon fiber because of its appreciable properties like low cost, low density, comparable specific tensile properties, nonabrasive to the equipment, nonirritation to the skin, reduced energy consumption, less health risk, renewability, recyclability, and bio-degradability. One of the main disadvantages of traditional fiber reinforced composite materials is its disposal, i.e., incineration. Drawbacks of NFC materials are high water absorption and poor wettability. However, several chemical treatments are available to overcome these drawbacks [2]. NFCs are a combination of polymer reinforced against natural fibers, namely, jute, sisal, banana, coir,

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