Surface Coated Building Studies in Health Care Sectors- A Review

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***Abstract*— Applications of the antibacterial and antifungal surface coating on the wall of the health care institutions or health care buildings for the prevention of the several infectious diseases. The review of the subjects has been critically studied by the researcher for the future explorations and research works.**

***Key words*— Surface coating, Nano-particles, Biological activities**

I. INTRODUCTION

In the modern developing age we need to find out several ways to exist the life very ease, comfortable, safe and sound. It is necessary to require the antibacterial effect for the daily using stuffs not only sanitary areas for instance of sewage and garbage disposal, lavatories, but also groceries, clothing, offices, schools, hospitals and whatever human being related protection at any where we would be active [1]. The recent technological and systematic life styles look out the significant attention about the safety precautions, sanitation and eco-friendly environments. Therefore the daily appliances are designed gradually more with antibacterial and antifungal attributes are implemented that provides security of human beings. Bacterial and fungal infection is one of the most important medical complications in the present situations [2]. Contagious diseases are caused through the pathogenic microorganisms like bacteria, algae and fungi. Infections can spread straight or in some way from one person to another or move toward in the infected regions. The controlled studies have been accomplished only to a limited extent. Normally the gram positive and gram negative bacteria are deliberated to the current communal health difficulties and to control these problems antibiotics have been used at the present situations to run away from the infections in the communal and sanatorium atmosphere [3].

Microorganisms are common in the environment and will develop on most plane surfaces offered nearby the sources of nutrients and availability of water. Mainly the funguses are expected organisms to grow up on the other hand, bacteria and viruses will stay alive on dry surfaces for some instances. The utilization of antimicrobial surface coatings is stated to destroy these microorganisms, so they cannot convey to other people and never accomplish to grow. The several numbers of biocide actives have been employed to pass on antimicrobial activity to the coating surfaces. Hence the painted surfaces are capable to carry the growth of fungi provided there is adequate quantity of water action at the surface and also be provided by the mist. Fungi consume the water soluble constituents of the paint coating and grow on damp surfaces causing considerable deformity, mainly due to spore formation which makes the growth easily noticeable. Fungal growth takes place in damp regions such as kitchens, toilets and bathrooms, where there is a lacking of ventilation [4]. Antibacterial surface coating paints have been formulated to conflict this problems, nevertheless it has established to be challenging a typical technology is been too expensive with a lesser amount of raw materials available such as copper, titanium and silver. Increasing the fungal growth on coating surfaces is also a major problem for the community with compromised health as well as safety from the infections. The Dublin Trinity College researchers have fabricated the novel and amazing additives for the surface coating paints that prevents the extending of hazardous infections of bacteria and fungi. Their formulated additives are hundred times cheaper than the other commonly used biocide in the paint industries as compare to the other antimicrobial coatings. The main advantages of these paints are low cost, less toxic, eco-friendly, and no colour change and non-carcinogenic in nature [5].

Therefore it is necessary to develop the antimicrobial or antifouling paint to combat such kind of problems which protects from the infectious diseases. Antimicrobial surfaces coatings are fabricated in the selection of several methods. Perhaps the coating paints are applied to a surface blended with the chemical compounds which are noxious to microorganism. Therefore the antimicrobial surface coating paints have been developed for their ability to keep surfaces hygienic in the health industry. Wherever the nature surface coatings are physical or chemical that can destroy the growth of microorganism resembling bacterial as well as fungal development which spread the infections [6].

II. LITERATURE REVIEWS

Maria Zielecka et al have prepared the silver and copper based nano-particles antimicrobial surface coating paints and impregnates. These paints were fabricated from metals applied over the nanoparticles by using silica including and put out of action of copper or silver. The Nano spheres are very effective against bacteria and fungus growth due to their harmless as well as eco-friendly properties. The prepared Nano spheres were analyzed their SEM, AAS, EDS and Photon Association Spectroscopy characteristics. The antimicrobial activities were screened against certain bacteria like E. coli, Staphylicoccus aureus and fungus species like Aspergillus niger, Paecilo mycesvarioti, Chaetomium globosum and Penicillium funiculosum with the silica as a standard [7].

Perez M. et al have been developed the new formulations of antifouling compounds. The blending mixture of cupric tannate and the bioactive pigments with lower concentration which forms the final antifouling compounds. Copper tannate gives narcotic effects on bio-fouling larvae. These antifouling compounds were tested for one year by the immersion of argentine painted on the panels showed macro fouling properties on the organisms. The excellent results was found by the decreasing amount of copper contents as compare to other copper based coatings because copper tannate shows excellent antifouling properties against microorganisms. Thus the performance of copper tannate containing pigment showed better antifouling activities and provides pollution free marine ecosystem [8].

Manawwer A. et al have reviewed the eco-friendly surface coating materials prepared from the vegetable oils. The vegetable oil showing their exclusive structure with the several functional groups like epoxides, hydroxyls, esters with its blending properties showed their polymeric coating characters. The important coating materials like alkaloids, polyesteramides, polyetheramides, epoxides, polyurathanes and polyols were blended with the vegetable oil which provides the better protective coatings [9].

Cacho C. D. et al. have developed 15- nanotechnology in the manufacturing the coating paints economically and profitably for the building walls. These paints were capable to protect from the pollutants and microorganism under the light for long time due to their progressively oxidizing properties. The photo-catalytic paints are very useful for the building environments because it sterile the environmental areas, degraded the pollutants and reduces the maintenance cost. Titanium dioxide is broadly used photo-catalyst in UV solar irradiation. For the protection of indoor atmosphere these new photo-catalyst were used [10].

Sousa V. M. et al have reported the multi-antibiotic resistant bacteria used in the huge numbers of clinical or medicinal infections. Due to this concern the development of disinfected indoor surface coating plays a vital role. The photo-catalytic water born surface coating paints like UV /TiO_2 was applied for the protection from the pathogenic bacteria [11].

Hochmannova L. and Vytrasova J. have investigated the interior surface coating paints. These surface coating paints were formulated by the mixture of acrylic dispersion in aqueous media and titanium dioxide with the addition of extenders and special additives like ZnO and different types of photo-catalytic agents. The reactivity checking of the photo-catalytic surfaces, organic dyes like Orange II was used as an indicator for the evaluation of antimicrobial effects of the coatings, agar plate method were adopted. The effectiveness of the coatings was demonstrated against bacteria as well as fungi and the best result was found for the controlling growth of microorganisms [12].

Abdllatif M. et al have been reported the antifouling surface coating paints amounting biocide activities on the marine organism by the contact of the sea water. It is found that, the toxic products mixed in marine water causes serious problems which increases the economic systems. In this paper, the formulation of antifouling surface coatings containing quaternary ammonium salts bonded with vinyl copolymer covalent anhydrous bonds which results the best antifouling properties. These formulated compounds were painted on the surface of marine ships for the protection from microorganisms. Thus the formulated coating gives prolonged protection against microorganisms [13].

Fay F. et al have been subjected the combined actions of antifouling compounds in copper less paints. The new antifouling surface coating paints were fabricated by the author's team. These coatings were prepared from the selected molecules with the prevention of physical and chemical actions. In the preparation method, a mixture of antiseptic chlorhexidine and antibacterial zinc peroxide which forms the final compounds named Tween-85. The tween-85 applied on the surface and contacted with sea water which create hydrogen peroxide layer that present from microorganism attack. These compound coating has been resulted the joint action of their molecules against micro and macro fouling [14].

Hellio C. et al have investigated the novel non-toxic antifouling agents used in the marine from the extraction of macro algae. Dichloromethane and ethanolic extracts made from the thirty marine algae were screened against thirty five isolated marine bacteria. These extracts were examined in the France and recorded their high inhibitory antibacterial activities [15].

Pelletier E. et al have reported the efficiency of chitosan and copper antifouling paints in an aqueous media. The field tests were performed in estuarine water evaluated with several natural and artificial chemical constituents blended into a silicone polyurathanes. It was observed that the cuprous oxide paints were effective against bacteria and algal attack. The chitosan based paints also gives anti algal actions with the addition of organic biocides like copper pyrithione and isothiazolone [16].

Vanit S. et al have developed the antimicrobial coatings for the paper boards by using clove oil. This paper contains the formulation of antimicrobial coating solution prepared from the natural oil extract of syzygium aromaticum blended with the modified starch media. The clove oil was diluted in DMSO solution in different percent concentrations and then applied in hydrophobic starch media and stirred it till homogenized. Then the mixture were coated over the card board and screened against different types of bacteria. Thus the coating mixture showed the good inhibitory activities against the growth of bacteria [17].

Arora S. et al the polymer based antimicrobial coatings as a potential biomaterial have been searched and reviewed by the author's team. In this paper it is stated that, the antimicrobial polymers were developed by holding active antimicrobial agent through acetyl or alkyl group holders. The use the antimicrobial polymers increases their potency against existing antimicrobial groups which reduces the environmental problems, residual toxicity and prolonging antimicrobial effects were illustrated in figures. The factor affecting antimicrobial activity, artificial fabrication process, antimicrobial activities of polymers and their applications in the different places were also demonstrated [18].

Mathiazagan A. and Joseph R. synthetic nano-sized particles and their importance have been explained in this review. The fabrication of organic coating blended with the different constituent nano particles with their tiny dimensions. The applications of nano particles in the paint formulation with pigments were especially focused in this paper [19].

Erakovic et al Studied the antifungal activity of Ag : hydroxyapatite thin films synthesized by pulsed laser deposition on Titanium and Titanium modified by TiO_2 nanotube substrates. The deposition by PLD of Ag:HA thin films on Titanium modified with TiO_2 nanotubes substrates monitored by a heat treatment at 500°C in water vapors for 6 hours allows for the fabrication of efficient shield barriers against adherence as well as contamination by the pathogenic fungus [20].

Fengna Chen, Xudong Yang and Qiong Wu have been studied the Antifungal competency of TiO_2 coated film on damp wood. In this study, the antifungal activity of TiO_2 photo-catalytic reaction against Aspergillus niger was investigated for moist wood boards during periods of several weeks. TiO2 coated film in the presence of UVA irradiation exhibited antifungal capability. No visible growth was observed on specimens during the photo-process. Re-growth appeared in subsequent dark, indicating that the photo-catalytic reaction was not sufficient for total disinfection against mold fungi but did suppress fungi growth. The study sheds light on conditions and potential applications of photo-catalytic deactivation of fungi [21].

Faria Khan et al have been demonstrated the Controlled assemblies of silver Nano fluid in Heliotropium crispum extract: A potent anti-biofilm and bactericidal formulation. The utilized method for silver nanoparticle (AgNPs) the synthesis for Heliotropium crispum (HC) plant extracts. Optimization of physicochemical parameters resulted in stable and rapidly assembled AgNPs. IR results suggest presence of plant phytochemicals that helped in the reduction, stabilization and capping of AgNPs. The assembled Ag nano composites displayed the peak surface Plasmon resonance (SPR) around 428 nm. The presence of uniquely assembled Ag-biomolecule composites, cap and stabilize nanoparticles in aqueous plant suspension. Spherical, uniform form of AgNPs with low polydispersion and average particle size of 42 nm and was determined through dynamic light scattering (DLS) and scanning election microscopy (SEM) which present robust interaction with microbes. The study also evaluates the antimicrobial and antibiofilm properties of biologically synthesized AgNPs on clinical isolates of MRSA, Pseudomonas aeruginosa and Acinetobacter baumannii [22].

Nadir Abbas et al have been synthesized multi walled carbon nanotube-TiO_2 hybrids for high performance antibacterial materials. This study reports an inexpensive sol-gel method to synthesize TiO_2-CNT hybrid materials. Synthesized TiO_2-CNT materials show strong antibacterial activity in the absence of light. The synthesis technique presented for the fabrication of TiO_2-CNT hybrid materials is inexpensive. Antibacterial tests with *E. coli* demonstrated that the addition of CNT significantly increases the antibacterial strength of TiO2 in the absence of light CNT. The prepared materials also showed the negligible cytotoxicity in-vitro cell examination towards HaCaT skin cell line [23].

N. Haghighia, Y. Abdi and F. Haghighi , Antifungal activity of TiO_2/ZnO nanostructures under visible light irradiation was investigated. A simple chemical method was used to synthesize ZnO nanowires. Zinc acetate dihydrate, Polyvinyl Pyrrolidone and deionized water were used as antecedent, capping and solvent respectively. TiO_2 nanoparticles were deposited on ZnO nanowires using an atmospheric pressure chemical vapor deposition system. The results of this study showed that preparing the TiO_2/ZnO hetero-structure caused a considerable enhancement in the antifungal activity of the both TiO_2 nanoparticles and ZnO nanowires. Comparing the relative number of the viable fungi on the prepared samples showed that the viability of the cells on the TiO_2 nanostructures under visible light after 5 hrs was about 4 times greater than the corresponding values for the TiO_2/ZnO hetero-structure [24].

Kuo-Pin Yu, Yi-Ting Huang and Shang-Chun Yang studied the antifungal efficacy of nano-metals supported TiO_2 and ozone on the resistant *Aspergillus niger* spores. The nano metals (Ag, Cu and Ni) supported catalysts successfully fortified by the incipient wetness impregnation method by the support of titanium dioxide nanoparticle. The antifungal experiments of *Aspergillus niger* spores were conducted on two surfaces in the darkness with and without ozone exposure, respectively. The critical Ag concentration to inhibit the germination and growth of *A. niger* spores of 5% weight nano Ag catalyst was 65 mg/mL, lower than several cases in previous studies. The inactivation rate constants of *A. niger* spores on nano metals supported catalysts in the presence of ozone were much higher than those in the absence of ozone. However, on the surface of TiO_2 particles, no antifungal effect was observed until 6 hrs exposure to ozone. Subsequently, ozone showed the synergetic effect on nano metals antifungal efficiency [25].

Jakub Kolarik &Jorn Toftum have been studied the impact of photo-catalytic paint on indoor air pollutants. They concluded the Step-change illumination of the paint in the room with building materials, decreased the perceived air quality. Introduction of human bio-effluents had an ambiguous effect on the perceived air quality. With non-illuminated paint, the acceptability decreased while an increase in acceptability was notices with illuminated paint. In either case, significant effects were observed shortly after the step-change. Emission of 1 cm^3/hr. of isopropanol had no effect on the perceived air quality in the test room which was polluted by building materials and human bio-effluents both with and without illumination of the paint [26].

III. CONCLUDING REMARKS

By the study of the above cited papers, the researcher can conclude the application of nanoparticles blending with the paint that can use for the protection of wall from the several types of bacterial and fungal stains. The researchers can implement their new ideas and techniques for the future workouts.

IV. FUTURE SCOPE AND PROPOSED WORKOUTS

Here the researcher can prepare the antimicrobial surface coating paints which is suitable for the indoor system in the healthcare institutes. And analyze the fabricated antimicrobial surface coating paints different methods or techniques. As well as check the antimicrobial activities against some bacterial or fungal species by the respective method. To apply the paints coats over plane surfaces and examine it, surface coverage/lit, cost of painting/sq. feet. Also optimize the calculation of different additives and constituents with their functions and quantities while blending the paint.

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