ISOLATION AND CHARACTERISATION OF MICROORGANISMS ASSOCIATED WITH PAINTS DETERIORATION IN STORAGE

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Abstract

Two samples of paints (emulsion and oil based paints) were analyzed for organisms that are responsible for their deterioration. The result revealed that *Bacillus cereus, Bacillus subtilis,* and *Staphylococcus aureus* were implicated in their deterioration. *Bacillus cereus* had the highest frequency of occurrence in both emulsion and oil based paints closely followed by *Staphylococcus aureus*. The fungi species isolated include *Pullularia* species, *Aspergillus niger, Aspergillus fumigatus, Aspergillus flavus*, *Trichophyton rubrum Microsporium gypzeum, Candida stellatoidea, Penicillum notatum*, *Trychophyton megninii*, *Mucor* species and *Alternaria* species. The results obtained suggest that microorganism of diverse genera are responsible for the deterioration of emulsion and oil paints.

1. Introduction

Paints are material that are applied on surfaces as a protective coating or decoration or a liquid coating applied to an object to protect it from wear and weather damages (Caroline, 1967). Paints are used to protect surfaces, make surface washable, decorate and identify the surface (Stewart and Tekel,1998). There are many different types of paints; each with a different set of character, these include: primers, house paints, masonry paints, marine paints and fire retardant (Kampman, 1972). They have different basic qualities which include consistency, opacity (hiding power), spreading capacity, adhesion and durability.

Painted surface are not always resistant to microbial deterioration unless the paint film contains an effective fungicidal ingredient, however, it may under certain environmental condition exhibit evidence of mould spotting or discolouration. The most common source of bacteria contamination of paint during application is a dirty paint brush. Good manufacturing and application practice can reduce microbial contamination of finished products and minimize the risk of microbial spoilage (Freeman 1989).

Contamination of paint in either its wet state or dried film can destroy the paint leading to both aesthetic and physical degradation of the painted surface. The types of microbial attack that are of concern to the paint industries are fungi, bacteria and algae (Buckman, 1997). Deterioration of paint is due to microbial metabolism of organic constituent of the paint. Many species of mould have been isolated from painted surface, these include species of *Aspergillus*, *Penicillium*, *Cladosporum*, *Pullularia* and *Alternaria*. *Pullularia* species appears to be the most common cause of paint deterioration as reported by Michael (1993), Los Bolton (1998) and the blue green algae (*Cyanobacteria*) (Adya, 1999). Several factors influencing the deterioration of paints in storage which include temperature, pH, nature and type of the paint (Michael,1993).

Microbial degradation of aqueous products is usually manifested as a loss in functionality, viscosity and phase separations. In addition, generation of gas and offensive odour can be a symptom of bacteria degradation of bulk stored or packaged aqueous raw materials (Wainwright, 1992). The objective of the study is to identify and characterize microorganisms that are responsible for the deterioration of paints.

2. Materials and Methods

(a) Collection of samples

Two samples of paints were used for this study. They include: Camalite emulsion paint made in Nigeria by Loamel Paints and Chemical Industries Limited, batch number 9102 (brilliant white in colour) manufactured on 0186/3/2003 and Camalite oil paint batch number 06C39 (chocolate in colour) manufactured on 00045/3/2002). The samples were purchased from a paint depot along Maitumbi Road, Minna, Niger State, Nigeria in a sterile container and then stored in a refrigerator at 4°C in the Microbiology Laboratory at Federal University of Technology, Minna.

(b)Enumeration and characterisation of Microorganism Isolated in the Paints Analysed

The bacteria were characterized according to the method described by Fawole and Oso (1988) in which the following reactions were examined: Gram staining reaction, spore test, motility test, starch hydrolysis test, catalase test, coagulase test, sugar

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fermentation test, methyl red test and indole test, these were later compared with other known taxa. However the fungi were identified by their morphological and microscopic appearance as described by Cheesbrough (1984).

3. Results

Table 1: Total counts of bacteria in paints analyzed

Sample	Name of isolate	Mean Bacteria count (Cfu/ml)
Sample A (camalite oil based paint)	*Bacillus subtilis*	5×10^5
	Staphylococcus aureus	3×10^5- $\times 10^6$
Sample B (camalite emulsion paint)	*Bacillus cereus*	6×10^5
	Bacillus subtilis	7×10^5-9×10^5
	Staphylococcus aureus	5×10^5

Table I reveals the mean bacteria count (cfu/ml) of each isolated organisms that are responsible for deterioration of emulsion and oil-based paints in storage.

Table 2: Total counts of fungi in paints analysed

Sample	Fungi	Mean Fungal count (Cfu/ml)
Samples A (camalite oil based paint)	*Aspergillus niger*	4.0×10^5
	Aspergillus fumigatus	4.0×10^5
	Trychophyton megninii	2.0×10^5
	Candida stellatodae	2.5×10^5
	Pullularia species	1.5×10^3
Samples B (camalite emulsion paint)	*Aspergillus niger*	4.5×10^5
	Aspergillus flavus	3.0×10^5
	Aspergillus fumigatus	4.0×10^5
	Mucor species	2.5×10^5
	Alternania stalletordea	2.0×10^5
	Candida stalletoidea	2.5×10^5
	Penicillium notatum	4.0×10^5
	Trychophyton megninii	2.0×10^5

Table 2 reveals the mean fungal count (cfu/ml) for each isolated organisms that are responsible for deterioration of emulsion and oil based-paints in storage

Table 3: Microorganism isolated from paints anaylsed

Samples	Fungal species Isolated	Bacteria species isolated
Sample A (camalite oil based paint)	Aspergillus *niger*	*Bacillus cereus*
	Aspergillus fumigatus	*Staphylococcus aureus*
	Trychophyton megninii	
	Candida stellatoidea	
	Pullularia species	
Sample B (camalite emulsion paint)	*Aspergillus niger*	
	Aspergillus flavus	*Bacillus cereus*
	Aspergillus fumigatus	*Bacillus subtilis*
	Mucor species	*Staphylococcus aureus*
	Candida stellatoida	
	Penicillium_ notatum	
	Trychophyton rubrum	
	Microsporum gypzeum	

Table 3 reveals the organism isolated and identified to be responsible for the deterioration of emulsion and oil based-paints in storage.

4. Discussion

The role of paint as a decorative and protective coating cannot be over emphasized and the usage is on the increase all over Nigeria. Microorganism, though very useful are capable of destroying and

disfiguring both aqueous and solvent borne coating materials. Microbes associated with the deterioration of paints as revealed in this study are: *Bacillus* cereus, *Bacillus subtilis* and *Staphylococcus aureus Aspergillus niger, Aspergillus, flavus, Aspergillus fumigatus Penicillium notatum, Trichophyton megninii, Trychophyton rubrum, Pullularia* species, *Pullalaria, Mucor* species *Candida stalletoidea* and *Alternaria* species. This is in line with the work of Cruegar and Cruayer (1982), Wainwright (1992) and Okpokwasili and James (1995) who isolated similar organisms in Kerosine, gasoline and crude oil. This result confirms that paints and paint products are subject to microbial contamination according to Buckman (1997). The major sources of the organisms may be the raw material used and improper methods of processing or storage.

Once the paint (emulsion) has been contaminated, its physical and chemical properties change. The microbial degradation of aqueous product in their wet state and the defacement or deterioration of coating films can be controlled or prevented through the use of anti-microbial additives called industrial biocides as reported by Wainwright (1992). Industrial biocides (anti-microbials) are used in coatings, this can be categorized as bactericides or fungicides. The selection of the most cost effective biocide system is dependent on the coating formation, manufacturing practice (plant hygiene), conditions during application, the end use and ultimately the climatic condition of the coating films.

Efforts should be made to check the proliferation of these organisms with the possibility of extending the shelf life of paints.

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