APPLICATIONS OF FOLDSCOPE IN IDENTIFICATION OF MICROBIAL GROWTH ON CONSTRUCTION MATERIALS

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Abstract:

This study is aimed to identify the applicability of fold scope on microbial identification from samples of building construction materials. Microbial identification process were exclusively depends on electric/electronic microscopes and overall it was cumbersome technique until economically cheap and user friendly microscope-Fold scope, made by Manu Prakash and Jim Cybulski, recently. Application of Foldscope dramatically increased the present study focused on diversity of microorganism and building material corrosion were studied. With this notion the present study conducted to identify the corrosion causing microbes which cause corrosion in building materials. Corrosion-the deterioration of materials, such as iron, steel, concrete and stone are biggest concern of building engineers as well as public. We have collected 1g of samples from corrosive materials and dissolved serially diluted. The diluted samples were plated on nutrient agar plates and SDA plates by spread plate for microbial growth. The identification were carried out by standard procedures. Results: Bacterial and fungal growth was observed in Nutrient agar and SDA plates, followed by Gram staining and Lactophenol cotton blue staining were done to observe bacteria and fungi respectively. Images were captured using foldscope clearly revealed the structure of bacterial and fungus presence in the samples. This study is a preliminary identification process of microbial involvement on corrosion building materials and further studies are warranted to identify the association of microbes with corrosion on building materials.

IndexTerms: Foldscope, Application Constructive materials, Bacteria Fungi, -

I. INTRODUCTION:

Corrosion is one of the leading economic loss in the constructive world. Though there are many factors are known to cause corrosion on constructive materials, microbes are believed to be one of the major factor that cause corrosion. But till date it is very difficult to identify the exact cause of corrosion on constructive materials from chemical based corrosion and microbial associated corrosion. Scientific report estimate around 20% of all corrosion failures are due to microbes. Microbes can interact in the environment with materials/surfaces in so many ways that make the complexity of the system too high to be evaluated by standard corrosion model predictions. Biofilm formation is an important factor to start a bio corrosion process, allowing the microbes to be in close contact with the surface and creating a microenvironment that can be totally different from the bulk with distinct properties: pH, dissolved oxygen. A biofilm is an elaborated tridimensional structure, with complex composition providing nutrient gradients. A biofilm producing bacteria is recognized as most targeted in construction materials, as they have been implicated in the corrosion of ferrous metals in several habitats and represent the main concern to many industrial operations due to their capacity to produce biogenic sulphide.

Metal corrosion results from (bio) consuming hydrogen, microbes stimulate cathodic reactions (Videla and Herrera, 2005) and they may also stimulate corrosion through the secretion of enzymes and acidic metabolites. The main types of bacteria associated with the corrosion of iron and steel are sulfate-reducing bacteria, sulfur-oxidizing bacteria, iron oxidizers, iron reducers, manganese oxidizers and microbes that secrete organic acids.

Most devastating corrosion occurs in the presence of a multispecies biofilm. In such biofilms the interactions between different species produced diverse metabolic product to exacerbate corrosion. Multiple corrosion-causing organisms in a biofilm can act synergistic and contribute to more severe corrosion than when only one single species is present. Different methods exist for sampling microbial populations on materials: swab, bulk, adhesive, contact plate, etc. but the in-situ collecting process has not been well standardized yet. Moreover, although many of these methods have been tested to evaluate their collecting efficiency on non-porous and non-absorbent surfaces (glass, steel, plastic, etc.), few studies have concerned construction materials such as concrete, coatings, mortar, and gypsum board, which are porous, rough and more or less dusty materials(Bertron, A. Mater Struct, 2014). The "Mould in the home" working group of the French High Council for Public Health has issued methodological recommendations for sampling on surfaces of building materials and suggests the use of at least two of the following surface sampling methods: swab, bulk sampling, adhesive tape and agar contact (imprint methods) in studies carried out on construction materials.

Steel and iron rods and other accessories microbial identification were tedious procedure at limited resource settings. In our study we collected samples from Steel, Stone, Cement, Alloys, Hollow Block, Tiles, Gravels Asbestos Sheet, Iron Plates, Brick, and Glass.

II. METHODOLOGY:

Sample Collection,

The following construction material samples were collected based on standard microbiological techniques sand, cement, wood, hollow block, tiles, gravels Asbestos sheet, iron plates, brick, and glass

Enumeration and Isolation of Bacteria

The collected sample was serially diluted (10-fold) using sterile distilled water. This is then inoculated on the agar medium by pour plate technique and incubated for 24–48 hours. Petri plates having countable colonies ranging from 30 to 300 are chosen for enumeration and counted.

Bacterial Identification:

The bacterial identification can be done by following standard procedure Bergeys manual of determinative bacteriology (Bergey D, 2000)

Gram staining :

Material and reagents used: Clean glass slides, Inoculation loop, Bunsen burner, Microscope, lens paper and lens cleaner ,Immersion oil, Distilled water ,reagents are

Primary Stain - Crystal Violet
Mordant - Grams Iodine
Decolourizer - Ethyl Alcohol
Secondary Stain - Safranin

III. RESULTS AND DISCUSSION

ISOLATION AND IDENTIFICATION OF MICROBIAL ISOLATES

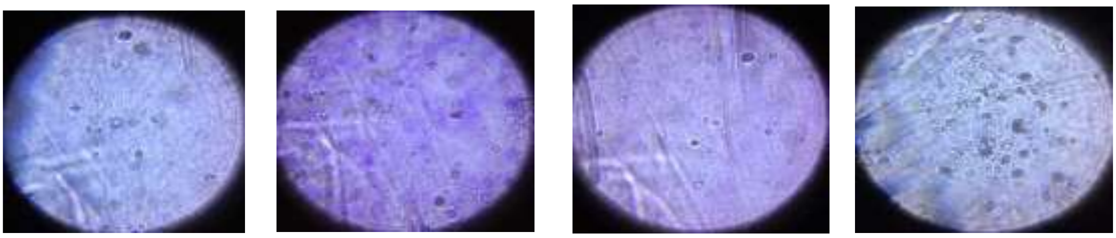
Out of 197 samples 1592 microbial isolates were enumerated and culture among these, 7 bacterial genus and 3 fungal genus were identified from the 197 samples collected from 10 different construction materials. All the Preliminary identification can be done by standard 'Bergeys' manual of determinative bacteriology Table -1, Fig-1 and 2.

Table 1: Enumeration and identification microbial isolates from 10 different construction materials

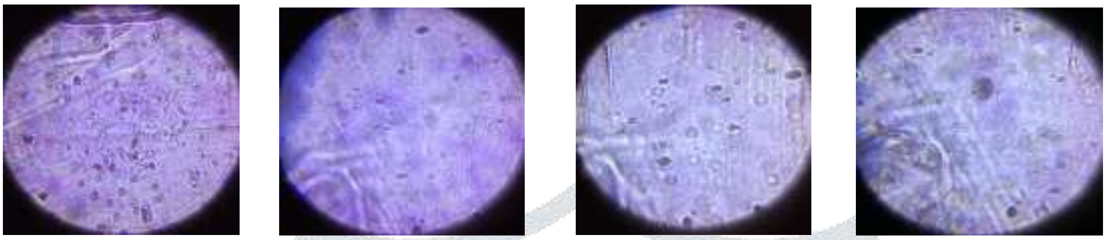
Sl.No.	Name of the sample	No. of samples tested	Isolates collected	Identified microbial isolates
1	SAND	19	167	*Pseudomonas sp.* *Shewanellasp* *Un identified bacteria*
2	CEMENT	32	321	*Bacillus sp.* *Pseudomonas sp.* *Shewanellasp*
3	WOOD	17	100	*Thiobacillussp.* *Bacillus sp.* *Desulfovibriosp* *Un identified bacteria*
4	HOLLOW BLOCK	16	147	*Pseudomonas flava* *Pseudomonas* *Shewanella*
5	TILES	18	278	*Penicilliumsp.* *Hormoconissp.* *Bacillus sp.* *Desulfovibriosp* *Un identified bacteria*
6	GRAVELS	20	128	*Un identified bacteria*
7	ASBESTOS SHEET	17	152	*Bacillus sp.* *Desulfovibriosp.* *Pseudomonas sp.*
8	IRON PLATES	13	47	*Fusariumsp.* *Penicilliumsp.* *Hormoconissp.*
9	BRICK	19	64	*Fusariumsp.* *Penicilliumsp.* *Hormoconissp.* *Un identified bacteria*
10	GLASS	26	188	*Un identified bacteria*
	Total	197 samples	1592 isolates	

Fig 1: Microscopic image of sample observed in fold scope

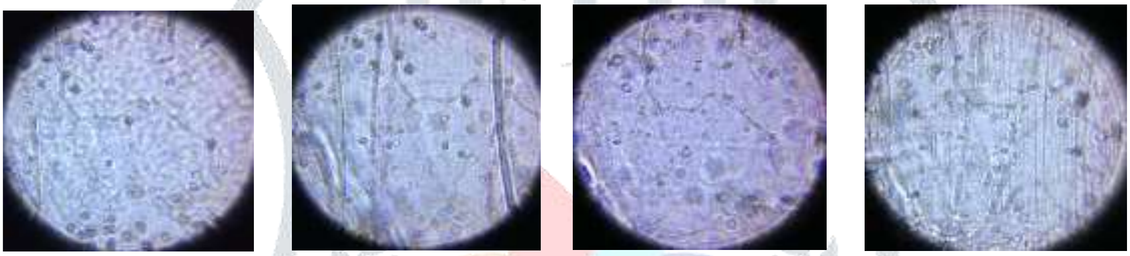
Sample 1 (SAND)



Sample 2(cement)



Sample 3(wood)



Sample 4(Hollow block)

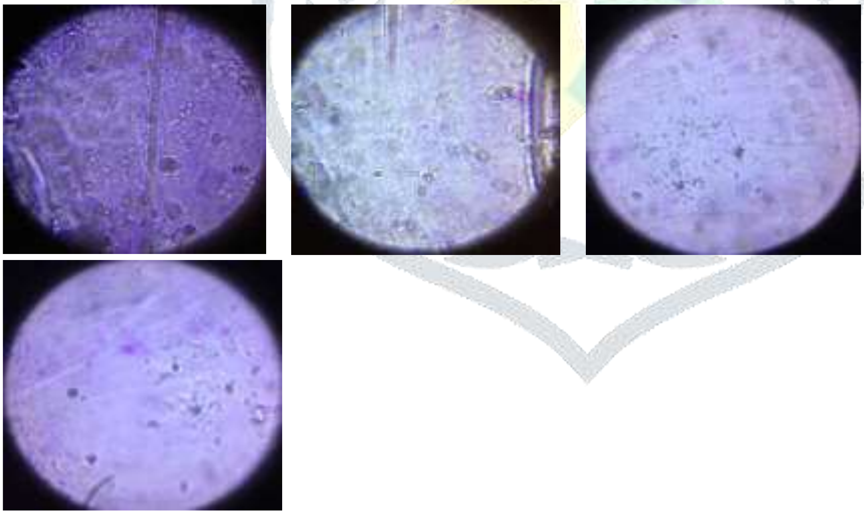
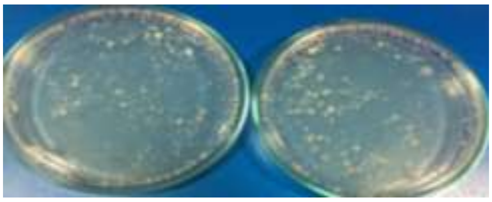


Fig 2: Enumeration of microbial isolates from construction materials

SAMPLE: 1(SAND)

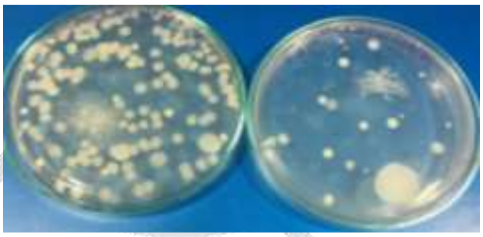
10^0 Dilution



10^{-1} Dilution

SAMPLE: 2 (CEMENT)

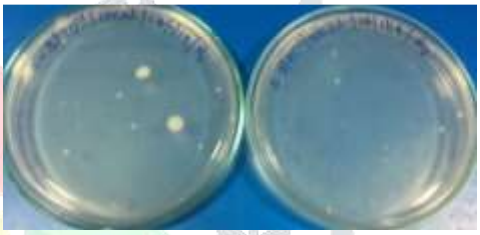
10^0 Dilution



10^{-1} Dilution

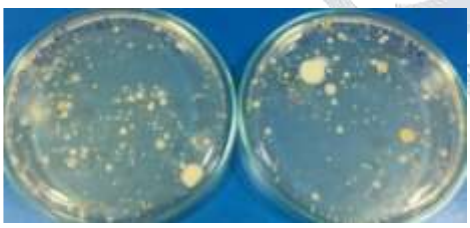
SAMPLE: 3 (WOOD)

10^0 Dilution



10^{-1} Dilution

SAMPLE: 4 (HOLLOW BLOCK)



10^0 Dilution

10^{-1} Dilution

DISCUSSION:

In our study, we have identified bacteria and fungi based on its morphological characters. All the collected samples from different sources were subjected for microscopical observation. Slides were used from the foldscope kit for Gram staining. Gram staining reagents were utilized from our bacteriology lab. Microbial Images observed with foldscope were captured by using cell phone camera and slides were observed and compared with standard laboratory compound microscope. Similarly, Foldscope were used by James S. Cybulski et al.,(Plos One 2014) for screening of parasites from blood smear. In their study they could observe parasites upon gram staining procedure. In our study the common Gram staining procedure followed to observe bacterial structures. In another study conducted by Stanford university, had reported foldscope usage on cancer cell diagnosis. But in this study we have not used any human samples or infection material for comparison. Since there are no other studies to compare with our work, we could reasonably conclude this is novel study for the application of foldscope on construction materials.

III Conclusion:

Detection of microbes causing corrosion or associated with corrosion constructive materials among the low limited setting resources has been challenging for construction engineers for long time. In our study we made an attempt towards finding an possible solution for this problem with the help of novel microscopic toll known as Foldscope. Interestingly in our study we could identified many microbes by using Foldscope and we were compared the bacterial images with standard compound microscope. Observed results clearly shows that Foldscope plays a vital role in identification of microbes present in the construction materials. From our study we could reasonably conclude this microscopic tool has great advantage over finding microbial samples on the construction materials by doing simple steps. Hence we strongly recommend for further usage of Foldscope for identification of microbes present in the construction materials, also it is an early step of finding microbes associated with corrosion and further studies are warranted to confirm its corrosive nature of microbes causing corrosion on constructive material.

IV. Acknowledgment

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