AN ANALYTICAL STUDY OF THE SEA WATER SLIME WITH REFERENCE TO BACTERIAL FLORA

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A detailed study of the primary film of slime with reference to the bacterial flora, its quality and quantity, as observed on different material surfaces exposed to sea water is carried out. A correlation has been established between bacteria and slime deposited on different surfaces.

INTRODUCTION

The role of "slime film" or "primary film" that settles on objects immersed in sea water in the subsequent macrofouling is an oft quoted controversy. Whedon (1937) considered primary film as very important for the fouling organisms. Miller (1946) and Spooner (reported by Haris, 1946) observed that foulers settled on surfaces before the formation of primary film. Zo Bell (1939) and, Cole and Knight-Jones (1949) showed that certain larvae of foulers settled more rapidly on filmed surfaces than on unfilmed ones.

The observations show that some foulers need this primary film for settling while certain others can settle on unfilmed surfaces. Composition of the primary film shows variations with respect to different objects. Zo Bell (1939) found that the primary film is composed mainly of bacteria. Wood (1950) observed that the film is composed of diatoms and algal spores. According to Daniel (1955) the slime is chiefly composed of diatoms and algae besides a small proportion of bacteria. The present study is an analysis of the primary film of slime with special reference to the bacterial flora, its quality and quantity, as observed on different surfaces exposed to sea water at a test site in the Cochin Port area.

MATERIALS AND METHODS

Test panels of size 30 cm. × 15 cm. × 0.07 cm. made of a aluminium/magnesium alloy (INDAL M575), galvanised iron, mild steel, marine quality copper, mild steel coated with anticorrosive paint ("Castle brand" zinc chromate) and, the same further coated with antifouling paint formulated by this Institute (Gopalakrishna Pillai, Balasubramanyan and Ravindran, 1968) and wooden panel (30 cm. × 15 cm. ×

TABLE I

QUANTITY OF SLIME COLLECTED AT INTERVALS

Type of panel	2hr. mg./cm.^{2}	4hr. mg./cm.^{2}	6hr. mg./cm.^{2}	8hr. mg./cm.^{2}	16hr. mg./cm.^{2}	24hr. mg./cm.^{2}	48hr. mg./cm.^{2}	7days mg./cm.^{2}
Wood	0.12	0.52	0.71	0.80	3.10	3.60	4.90	5.20
Aluminium/magnesium alloy	0.05	0.35	0.62	0.70	1.80	1.95	2.60	3.20
Mild steel	0.08	0.50	0.78	0.80	2.70	2.80	3.10	3.60
Galvanised iron	0.08	0.40	0.60	0.60	1.70	1.95	2.80	2.90
Copper	Nil	0.01	0.08	0.20	0.28	0.30	0.32	0.36
Mild steel painted with anticorrysive paint	Nil	0.20	0·48	0.80	1.20	1.50	1.90	2·40
Mild steel painted with anti-corrosive and antifouling paint	Nil	0.30	0.25	0.30	0.45	0.50	0.65	0.72

TABLE II

SETTLEMENT OF BACTERIA ON VARIOUS PANELS

Type of panels	Percentage of physiological group				
	Total count	Nitrate reducing bacteria	Sulphate reducing bacteria	Cellulose digesting bacteeia	Iron reducing bacteria
Wood	1.1×10^{5}	40	30	12	Nil
Aluminium/magnesium alloy	9.1×10^{5}	60	20	5	15
Mild steel	9.5×10^{5}	60	10	10	20
Galvanised iron	9.9×10^{5}	30	40	7	10
Copper	6.0×10^{4}	40	20	2	Nil
Mild steel panel painted with anticorrosive paint	9.4×10^{4}	49	31	6	2
Mild steel panel painted with anticorrosive and antifouling paints	6.4×10^{4}	34	26	5	Nil

1.2 cm.) made of mango wood (*Mangifera indica*) were exposed to sea-water at a site near the Cochin Port one foot below water line. Slime accumulated on these panels were collected at intervals of 2 hr., 4 hr., 16 hr., 24 hr., 32 hr., 2 days, 4 days and 7 days taking precautionary measures to prevent contamination by terrestrial bacteria to the extent possible following the methods of Zo Bell (1946).

The medium employed for pour plating of the sample was sea water agar, from which random colonies were picked. Bacteria was classified into various physiological groups like nitrate reducers sulphate reducers, iron reducers and cellulose digesters according to the methods adopted by Zo Bell (1946) and Conn (1957). The chemical constituents of the slime were determined according to the methods of A.O.A.C. (1960).

Results And Discussion

The quantity of slime collected at different intervals is presented in Table I. A perusal of the Table shows that the settlement of slime is predominent on wooden panel which varies from 0.12mg./cm.^{2} to 5.2 mg./cm.^{2} when examined after 2 hrs. and 7 days respectively. Accumulation of slime was least on copper panels followed by M. S. panels coated with antifouling paint. Quantity of slime accumulated on other materials was between those on wood and copper.

The reason for the greater quantity of slime accumulated on wooden panel is the non toxic nature of the substratum. Waksman, Johnstone and Carey (1943) found that zinc is less toxic to bacteria compared to copper. Galvanised iron panels and panels coated with anticorrosive paint are less toxic, and hence the slime is more on these panels, compared to toxic panels like copper.

Table II presents the percentage and total count of nitre reducing, sulphate reducing, iron reducing and cellulose digesting bacteria present in the slime settled on different panels. Examinations of Tables I and II shows quantity of slime and total count of bacteria were high on wooden and non toxic metallic panels.

Bacteria is always present in the slime deposited on metallic or non metallic panels submerged in sea water but the bacterial count varies with respect to the available organic matter present in the slime. The organic matter provides the food for bacteria and plays a major role in their proliferation (Waksman, Johnstone and Carey, 1943). The constiuents of the slime film were analysed and the percentages of organic matter, insoluble ash and salt content in the slime are given in Table III. The analysis showed that slime film deposits on wood contains 27% organic matter (dry weight). The copper panels accumulated the least percentage of organic matter. The percentage of organic matter present in slime accumulated on other materials was between that in copper and wood. Accumulation of bacteria in the slime on these panels also follows a similar trend. Toxic nature of the panels thus plays a role in the settlement of bacteria and the formation of slime.

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TABLE III

CONSTITUENTS OF DRY FILM AFTER 7 DAYS

Type of panel	Percentage of the constituent of the slime (dry weight)		
	Organic matter	Insoluble ash	Salt content
Wood	27.0	52.0	20.2
Aluminium/magnesium alloy	14.5	43.5	31.8
Mild steel	23.0	41.6	31.8
Galvanised iron	18.0	42.6	33.8
Copper	11.5	42.8	41.7
Mild steel panel painted with anticorrosive paint	25.0	45.5	28.2
Mild steel panel painted with anticorrosive and antifouling paints	14.5	40.9	52.4

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