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A SUCCESSFUL METHOD OF PREVENTING FOULING IN SEA WATER CONDUITS BY ELECTROLYTIC CHLORINE GENERATION

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ABSTRACT

The fouling of seawater inlets of ships and shore structures and its effect on their operational efficiency have been examined. Available methods of control have been studied and a comparison has shown that chlorination of seawater is the only suitable method. Methods of chlorination of seawater have been investigated and the advantages and disadvantages of the methods are discussed. A method developed at this laboratory has been found to be most suitable on the basis of investigations carried out both in the laboratory and field conditions for the effective control of marine fouling.

FOULING PROBLEMS

The marine fouling of the internal surface of pipes and conduits employed for distribution of seawater in ships, industrial plants and other shore and offshore establishments is a critical problem to the user. The fouling in conduits of ships is particularly more severe since their pipe line which is comparatively smaller in diameter, is designed for high velocities of water transport. It has been reported that in ships stationed in the tropical waters of Hawaii, the fouling of inlets was so extensive that ships had to be recalled every 18 days for cleaning of condenser tubes (Redfield & Hutchins, 1952).

Generally the fouling of conduits is caused by a complex variety of organisms like barnacles, tube worms, bryozoans, hydroids, sponges, tunicates and mussels. Among the various groups of organisms chiefly encountered in India as consistent foulers, barnacles, hydroids and mussels are of great importance. At Visakhapatnam a dreissinid mollusc *Mytilopsis sallei* (Recluz) has become a most predominent fouler of seawater inlets and conduits and the inlets of ships when dry docked were found completely blocked by *M. sallei* (Figs. 1 & 2).

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Preventive Measures

Although the problems of conduit fouling has been most frequently experienced by a number of industries like Electrical power stations, atomic reactors, oil refineries, fertilizer industries and the ships both merchant and naval, suitable control measures universally acceptable are not yet known. In general, the various preventive measures either tried or suggested by the previous workers can be classified into two groups viz. physical methods and chemical methods of control. These have been described in detail by Dobson & Short Hills (1964) and hence is beyond the purview of this paper.

Only chlorination of seawater among all the methods suggested has been found to be most effective and suitable for controlling fouling settlement in the seawater circuits. Clapp (1950) and Pattern (1950) had successfully employed liquid chlorine cylinders for introducing toxic doses of chlorine in the seawater in their studies. However, this method cannot be employed on board ships and particularly on warships, thus necessitating examination of other methods of chlorination. Bartha (1964) reported successful control of fouling in seawater systems by introducing solutions of sodium hypochlorite at a suitable point nearer to the inlet of seawater. This method was also examined by this laboratory for its suitability, but it was observed that the method not only requires additional space for keeping reservoir and pump, which is not advisable on warships where space is at a premium, but it also requires additional recurring expenditure on huge quantities of chemically unstable sodium hypochlorite solution.

Adamson *et al* (1963) on the other hand observed that chlorination of seawater is also possible by simple electrolysis of seawater to generate required quantities of chlorine. The principle was later adopted by Lovegrove and Robinson (1968) in order to bring about prevention of fouling on large surfaces of mild steel immersed in the sea. The laboratory undertook an investigation to examine the possibility of employing this principle in effectively preventing fouling settlement in sea water systems.

Service Trials

The experiments on the control of fouling by electrolytic chlorine generation in the field were found to prevent fouling successfully (Ganti & Kalyanasundaram 1973). It was observed in the field experiments that marine fouling in conduits was completely controlled by the chlorine generation method without affecting the metal. The experiment was then extended to a full scale service trials on a sea water system in use on board ship. The system designed for service trials was mounted at the grating of the sea water inlet of the forward air conditioning plant as shown in Fig. 3.

The leads coming from anode (platinum) and cathode (stainless steel) were taken through a water tight junction box and the line was then taken through the interior of the inlet through a water tight gland into the engine compartment. The power was then fed to the system by means of a stabilized power supply unit and a current of 500 mA was maintained. The system as fitted above was under trial for 9 months. At the end of the trial period the ship was brought to dry dock to record the results.

It can be observed from Fig. 5 that the electrolytic chlorine generation system developed at this laboratory effectively protected even the areas around the inlet and grating of ship against the settlement of marine fouling. The grating was removed and the interior of the inlet was examined and found to be not only free from any fouling settlement but was also free from the normal diatomaceous primary film (Fig. 6). Both the cathode and anode units remained unaffected even after such long exposure as can be seen from the above photograph. Further there was no sign of corrosion on either the grating or the interior of conduit. After ascertainig that the present design of the system has totally prevented any fouling settlement, the ship was sent out again, allowing the trials to continue. As on date even after two and half years of trial, as observed from the daily records received from the ship, the unit is functioning without any difficulties.

The system of electrolytic chlorine generation developed at this laboratory has proved a most successful method for controlling fouling in any system employing seawater for various purposes. The application of this method in a wide variety of shore, and offshore and large number of industrial plants would prevent the fouling settlement at a very low cost. In fact after initial investment towards the installation of the unit, the system neither requires any particular maintenance schedule nor any frequent recurring expenditure. The system is being patented.

References

Adamson, A.F., Lever, B. G. and Stones, W. F 1963 The production of hypochlorite by direct electrolysis of seawater : electrode material and design of cells for the process. *J. Appl. Chem.* 13, 483-495.

Bartha, S. 1964 Problems of operation and fouling in sea water circuits on ship board. *Proc. Scandinavian Corr. Cong.*, 1-9.

Clapp, W. F. 1950 Some biological fundamentals of marine fouling. *Trans. A.S.M.E.*, 72, 127-131.

Dobson, J. G. and Short Hills, N. J. 1946 The control of fouling organisms in fresh and salt water circuits. *Ibid* 68, 247-265.

Ganti, S. S. and Kalyanasundaram, N. 1973 Prevention of marine fouling in conduits by electrolytic chlorine generation technique. *Sci. & Cul.*, 39, 349-551.

Lovegrove, T. and Robinson, T. W. 1968 The prevention of fouling by localized chlorine generation. Biodeterioration of materials. Elsevier Pub. Co. Ltd., London. 617-638.

Patten, I. A. 1950 Project study for the mitigation of marine fouling. *Trans. A.S.M.E.* 72, 109-115.

Redfield, A. C., and Hutchins, L. W. 1952 Marine fouling and its prevention. U. S. Naval Institute, Annapolis, Maryland, 11-14.

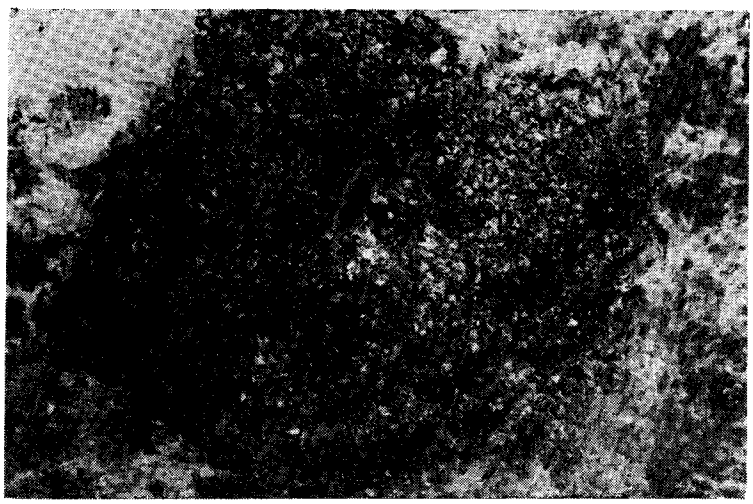

Fig. 1. Inlet of a ship completely blocked by settlement of *M. sallei*

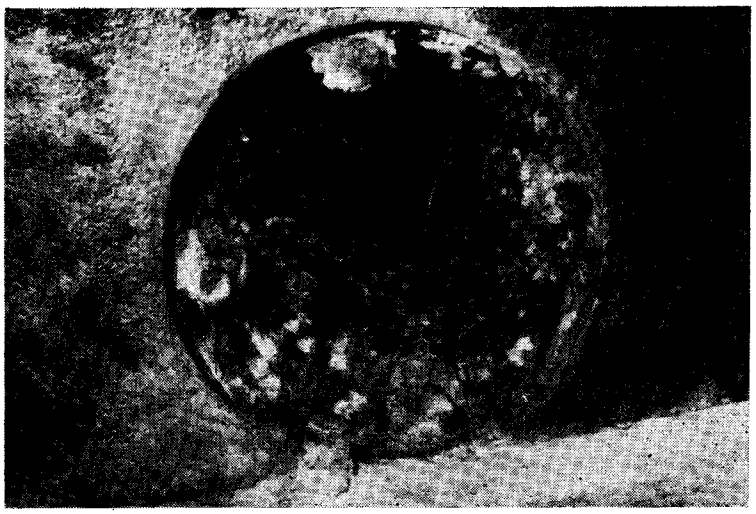

Fig. 2. Interior of the same conduit showing varied fouling settlement

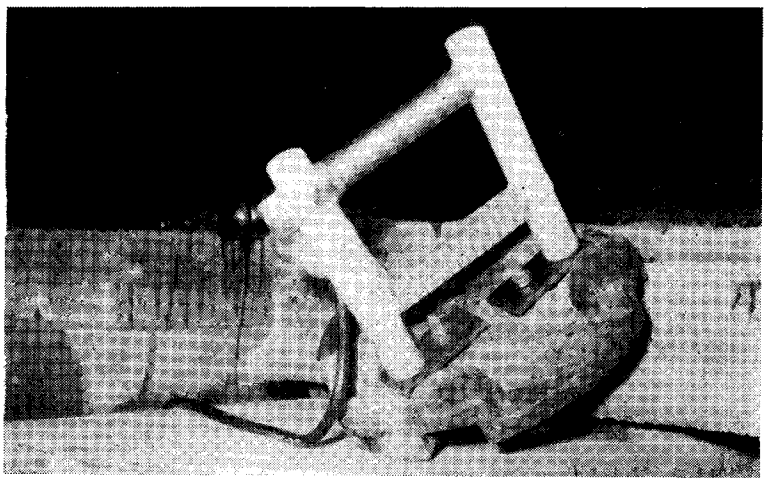

Fig. 3. The electrolytic chlorine generation unit fitted on the, grating before installation.

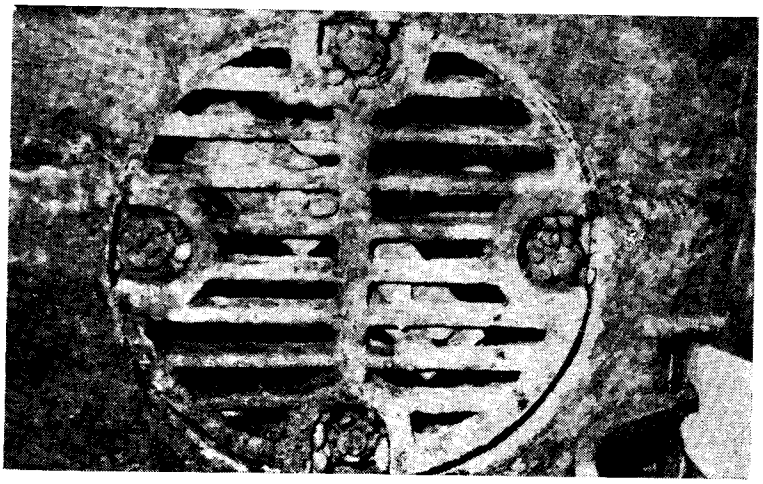

Fig. 4. Inlet in Fig. 1. showing complete fouling protection at the end of 9 months service trial.

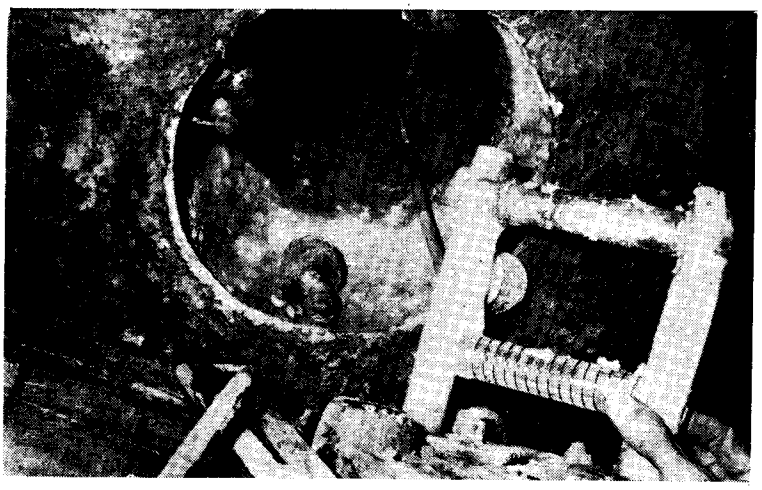

Fig. 5. Interior of conduit showing complete fouling protection after trials.