

KEEP YOUR POWDER DRY!

BY

ENGINEER LIEUTENANT-COMMANDER M. J. W. CRANE, R.N., C.ENG., M.I.MAR.E.

(C.-in-C. Fleet Technical Staff)

The tube shown in FIG. 1 was one of many removed from the superheated pass of a Dieso-burning Y.100 boiler. It had only been in service for three years and was perforated at the lower end immediately above the water drum. Two quite similar perforations and evidence of excessive external corrosion in other boilers led to an urgent inquiry into the causes of these failures being undertaken by C.-in-C. Fleet Staff and D.G. Ships. It was soon evident that the trouble related to a substance variously described as 'a greeny yellow slime', 'a sticky yellow lacquer', 'brown, black and green layers of powdery deposit', or 'a clear sticky varnish'. An analysis of some deposits taken from a Y.136 boiler water-drum, in fact, revealed a content of nearly seven per cent by volume of free H_2SO_4 . Following further analyses, it became evident that the colours and consistencies observed indicated iron sulphate and iron sulphite in various concentrations and solutions with an admixture of carbon soot.



FIG. 1

Those not entirely convinced of the aggressiveness of the deposits in the presence of iron were exposed to the 'Staff Paper-Clip Test'. This was devised by a Fleet staff officer who prefers to remain busily anonymous. Accepting the encroachment on his leisure hours with the resignation for which these officers are renowned, he arranged two test tubes of water in each of which was suspended a paper clip. In one of the test tubes a few crumbs of the ubiquitous green/yellow deposits were placed. The experimenter waited (undertaking other 'non-interfering' tasks in the interim!) for three days and, behold, the paper clip immersed in a solution of the deposits had completely dissolved. The control sample was untarnished and testified to the quality of HMSO's paper clips, while clearly inviting concern over the extreme aggressiveness of the deposits. A rather more sophisticated experiment was conducted elsewhere with a length of boiler tube immersed in a weak solution of the deposits. The tube was measured periodically and the rate of external wall corrosion showed that a tube would have become perforated in this environment in rather less than twelve months!

It was apparent that a penalty of burning Dieso under certain types of boilers might be an increase, compared with burning FFO, of the rate of deposition of sulphur compounds in various parts of the boiler. This, perhaps, is surprising considering that Dieso contains, by specification, approximately one quarter of the upper limit of sulphur content specified for FFO.

This conclusion was supported by D.G. Ships and the Admiralty Marine Engineering Establishment, although the many sometimes obscure parameters governing the rate of deposit still await full investigation. It is interesting to observe that Y.100 boilers, with some exceptions, appear to be most vulnerable to the build up of deposits and intensity of attack at the water drum tube ends. Other boilers seem to experience corrosive attack at economizer and uptake levels. Ships refitted at Chatham would seem, for no obvious reason, to have substantially more deposits of the nature described, than ships refitted at Rosyth, Portsmouth and Devonport. Very firm evidence also shows that port boilers of all classes of ships are, in general, dirtier, have more heavily corroded casings and pressure parts, suffer more tube failures and are subjected to more rapid brickwork and insulation deterioration than their starboard counterparts. Currently these observations lend themselves to no readily accepted explanations but speculation would suggest that the MEO of a Chatham refitted Y.100 *Leander* should keep his outfit of tube plugs somewhere adjacent to his port boiler!

The investigations continue and when a valid corrosion pattern has been established, a solution will, it is hoped, be available. The palliative most readily applied is however that suggested in the title of this article: 'Keep Your Powder Dry'. The aggressiveness of the solutions of deposits of FeSO_3 and FeSO_4 decreases dramatically with the removal of H_2O , and it is now vitally important to heat and ventilate (preferably together) boilers in the shut-down condition. Reduction of deposits by attention to correct combustion and the correct use of efficient soot blowers is also important, as is the prudent, but so often neglected, precaution of ensuring that a funnel cover actually covers the funnel (but allowing a small outflow of ventilating air), and that gas and air casings are in fact capable of keeping water out.
