Paper No. 5173.

"The Work of the Paint Research Laboratory of the London, Midland and Scottish Railway Company." †

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Mr. C. W. Clarke, of Bombay, observed that the Author's recommendation that painting should not be carried out when the temperature of the structure was below the dew-point appeared to be substantiated by experience in painting coaching stock on the Great Indian Peninsula Railway. On that railway there were two workshops dealing with the painting of coaching stock. All the main-line stock was painted at Matunga, a suburb of Bombay, whereas branch-line stock of the northern section of the railway was painted at Jhansi, situated in the United Provinces, over 500 miles from the nearest point on the coast. The climate of Bombay was humid, whilst that of Jhansi was most arid. The labour in Bombay was more highly paid and in general greatly superior to that available in Jhansi, where the labour recruited was usually the local *ryot* (agricultural worker). Paints to the standard specifications and tests of the Indian Stores Department were supplied to both workshops in drums. Both workshops worked to the same painting schedule, and it was noticeable that the paintwork on a coach coming out of Jhansi workshops was superior in finish and durability to that of one from Matunga. In his opinion the only explanation possible was that the temperature of the steel body-panels on the coaches in the paintshop at Matunga was very often below the dew-point. In neither workshop was air-conditioning or air-heating employed. Abrasion of the paint-surface due to the great amount of dust in India was most pronounced, and he thought that the Author's test for resistance to surface-abrasion could be developed into a most useful physical test to include in any specification for paint for body-panels of coaching stock. Before such a test could be standardized, it would be necessary to specify the grain of the carborundum powder used, and the dimensions of the aperture at the bottom of the vessel containing the carborundum powder, as variations in either would affect the wear of the paint-surface under test.

The nature of the surface-soil had to be considered in selecting a suitable paint. For example, the soil in Western and Southern India was generally acid, whereas that in Northern India was largely alkaline, and the dusts from those soils affected the life of the painted panels on rolling stock.

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† Journal Inst. C.E., vol. 9 (1937–38), p. 140 (June 1938).

Had the Author considered the effect of temperature on a painted panel? The surface-temperature on body-panels of coaching stock in India might exceed 150° F. for many hours each day during the hot weather, and that continued baking of the paint-surface tended to produce a very brittle skin, which accelerated peeling.

Dr. J. Newton Friend was glad to note that British railway companies were giving serious consideration to the question of paint. For many years the paint-industry had suffered from the popular misconception that any one could paint provided he was given a good brush and good paint. It was now beginning to be realized, however, that such was not the case. Shockingly bad results might be obtained with a first-class paint, simply because it had been badly applied. Further, it was essential to break away from the idea that, because a paint was well made and was suitable for a particular type of work, it was therefore the best to use for a different job. The user would have to learn to select the best type of paint for the work in hand.

The paints used by railway companies were required for three main purposes, namely protection, decoration, and intelligence. The last-named comprised those required for lettering, signals, etc., the colour playing an important part. It would be obvious that fading or darkening might be a very serious fault in such a paint whereas it might be no disadvantage whatever in a paint required for purely protective purposes.

The Author very properly stressed the importance of carefully preparing surfaces prior to painting, particularly in the case of iron and steel. It would be an enormous advantage if manufacturers could supply their steelwork covered with the thinnest possible layer of an elastic mill-scale which would cling tenaciously to the underlying metal, like the well-known skin on cast iron, and thus help to preserve it from corrosion. Actually, however, it was the tendency of the mill-scale to crack and fall away which rendered it so dangerous to steel structures exposed to corroding agencies. Corrosion became localized at the break, and not only might serious pitting occur but rusting proceeded, perhaps quite unobserved, under the still-adherent scale, gradually loosening it until it fell away in patches carrying its coat of paint with it. The serious nature of the pitting induced in steel by the presence of scale when exposed to sea-air and sea-water was well brought out in the photographs published [1] by the Sea-Action Committee of The Institution. There could be no question that the removal of scale prior to painting was most desirable. The problem was thus entirely different from that presented when steel was to be embedded in Portland cement. Many engineers imagined that the cement prevented the corrosion of the embedded metal because it kept the moisture away. That, however, was not the whole story, for cement was

[1] Fifteenth Report of the Committee on the Deterioration of Structures exposed to Sea Action. H.M. Stationery Office, 1935.

porous. The real effectiveness of the cement lay in its alkaline nature. As the coating of cement was relatively thick, the alkali was not readily leached away, and any leaching action could be retarded by covering the cement with bituminous material. Hence there was no need to de-scale steel destined to be surrounded by cement, and that admittedly expensive treatment might be safely omitted. As the Author pointed out, however, a paint film was exceedingly thin and, although chromated pigments were often used in priming paints because they tended to inhibit corrosion, their value was reduced, particularly in subaqueous work, by leaching.

It would have been thought that the removal of scale by stretching the metal would have had a deleterious effect upon the subsequent life of the metal, but the proof of the pudding was in the eating, and the Author had not observed any such effect. That was very reassuring, and was gratifying to Dr. Friend, who had, for many years, felt that the effects of stresses on the tendency to corrode had been unduly magnified [1].

Mr. N. N. Maas, of Shanghai, observed that the Author stated that after specifications were drawn up to cover the quality of separate ingredients and proportions were standardized, the authorized formula was put into operation in the works and watched to ensure that the composition was being adhered to. The Author did not, however, mention whether the specification restricted the manufacturer in any way as to the method and machinery adopted in producing the paint from the ingredients. In few other process trades could there be more variety in regard to the procedure and the machines used in achieving the finished article than in the paint-making trade. An investigation would probably reveal that no one manufacturer produced paint in the same way as, and by similar machines to, those of any other manufacturer.

It would probably be agreed that paint did not merely consist of a complex of drying oil, pigment, drier and thinner, but that those substances had to be mixed, refined, and brought together in a special way. A difference in the process by which those operations were brought about (reference to which might be found in a Paper [2] by Mr. Maas) would undoubtedly be reflected in the qualities of the final paint. If the proportions of the ingredients could be accurately tested after the paint had been manufactured it would almost certainly be found that paint produced from the original formula, but by dissimilar processes, would show variations from the initial proportions of its constituents as well as differences in its physical properties. Too little attention had been paid to the actual mixing, homogenizing and refining processes in paint-making, whereas a wealth of industry, care and research had been lavished on the ingredients and their properties. There was certain to be an optimum process for

[1] "A Study of the Resistance of Over-Stressed Wrought Irons and Carbon Steels to Salt-Water Corrosion." Journal Iron and Steel Institute, vol. cxvii (1928), p. 639.

[2] "Paint-Making Machinery." Trans. Inst. Engineers and Shipbuilders in Scotland, vol. 78 (1935), p. 413.

each particular kind of paint; in consequence, the particular process to be employed should be definitely specified.

The Author did not mention whether a maturing period was included in the specification. Paint taken directly from the final refining process or machine might not exhibit the same qualities as the same paint allowed to mature, say, for 6 months.

If the Author would express his opinion on those matters it would be of great assistance to other large users of paint, who would gladly welcome the information which the Paper imparted.

Mr. H. J. Troughton observed that on p. 145 § the Author gave a list of properties of paint; under No. 8 "Colour" he discussed shortly the question of comparing colours, remarking, "Instruments are available for measuring colour in terms of the three primaries, but those which are efficient are too costly for use in routine testing." That might be the case, but Mr. Troughton did think that some method should be evolved, even if it were not yet available. The cost of testing would presumably depend partly on the accuracy required, and it would not be necessary to make a routine test of every purchase of paint.

There were many colours used which were fairly well standardized, and the makers' usual colours were near enough. When, however, paints were required for rolling stock, especially road passenger-coaches and 'buses, the matter was rather more important, and one of the greatest difficulties that he had encountered was in keeping to standard colours when once they had been settled. Usually that was originally done by visual inspection, since æsthetic considerations were the most important, and for them the eye had to be used. After having chosen the colours, paint might be purchased from several makers over a period of years; if the vehicles were examined after a year or so many differences would be found, partly, of course, due to fading or darkening, but also due to the facts that samples had not always been matched from the originals, and that the originals themselves had altered when used for matching purposes.

Shortly after the War, when reds were not so good as they were now, he had had to deal with red vehicles and had purchased a tintometer; it seemed possible to keep the colour within a few shades of the original without much difficulty, and with a piece of apparatus which, to his recollection, was not very expensive. Recently, however, he had taken over a fleet painted blue and yellow; even in vehicles delivered by the same builders during the last few months there were variations in colour, and when the fleet was lined up in the depot the differences were very apparent. It did seem to him that some reasonably-priced instrument could keep such variations within narrower limits. He now had access to a tintometer in a nearby Technical College, and he hoped that in a year

§ Page numbers so marked refer to the Paper (Journal Inst. C.E., vol. 9 (1937–38), p. 140. (June 1938.)—Sec. Inst. C.E.

or so the wide range of shades on the vehicles would be limited, but, more important still, the original approved colours should be capable of reproduction without much trouble at any time within fairly narrow limits.

The Author, in reply, observed that the points raised served to emphasize the extreme complexity of the subject, and suggested a wide scope for future investigations. It was important to appreciate, as Dr. Newton Friend pointed out, that a paint suitable for one situation might be quite unsatisfactory in another. The Author's aim had been to develop paints which gave satisfactory service over the widest possible range of conditions, but even so, the number of paints necessary to meet the diverse circumstances encountered within the L.M.S. Railway Company's activities was very considerable.

The greatest importance was attached to correct methods of manufacture, which should ensure that the manufacturer was properly equipped before contracts were placed, with the object of ensuring that properties such as satisfactory wetting of the pigment and the optimum particle size of distribution, were properly safeguarded. The stress laid by Mr. Maas on that aspect of the subject was well placed.

With regard to a maturing period, although reference to a particular period did not appear in the L.M.S. Railway Company's Specification, steps were taken to ensure that materials when received were in a condition suitable for immediate use.

The Author did not wholly share Dr. Friend's view with regard to the need for de-scaling of steel to be encased in concrete, since stray electric currents might bring about that corrosion which it was so necessary to avoid; he tended to the view that it was better to de-scale and coat the steel with an insulating material, such as bitumen, before it was encased in concrete.

Some years ago, an experiment was carried out in order to discover what the effect was on painted surfaces of temperatures of up to 180° F., and the results showed that temperatures of the order mentioned were without appreciable effect upon the durability, but that the destruction of the paint-film was rapidly induced by light from the ultra-violet end of the spectrum. Mr. Clarke's details relating to his experience on the Great Indian Peninsula Railway were particularly interesting.

The advent of a cheap and efficient tintometer that would permit rapid comparison of colour and be generally suitable for routine work would be welcomed. Provided that the material conditions were carefully controlled, the visual examination at present used was satisfactory for most practical purposes.