Coal Extracts as Promoters of Dropwise Condensation of Steam

WHEN a very thin layer of a hydrophobic material is deposited upon a steam condenser tube, 'dropwise' rather than the more usual 'filmwise' condensation of the steam occurs ; and, owing to the elimination of the poorly conducting water film, the rate of heat transfer and therefore the rate of condensation is considerably increased. The capacity of a steam condenser of given size treated in this manner would be much greater than that of an uncoated condenser.

It has been found that when coals are extracted with certain organic solvents, an appreciable fraction of the coal substance is dissolved[1], and that the extract, after removal of the solvent, exhibits marked hydrophobic properties[2]. Promoters of dropwise condensation so far developed either have too limited a life in practice or contaminate the steam. It was thought possible that coal extracts might supply alternative materials for condenser-tube treatment which would prevent filmwise condensation over extended periods of use.

It is possible to obtain many kinds of extracts from different coals or carbonized coals by the use of a wide range of organic solvents. In the work described in this communication the results obtained with only two of the many that were tested are reported. These extracts were : (i) that obtained by the exhaustive Soxhlet extraction of a low-rank, free-burning coal with methyl-cyclohexanone (Sextone *B*), and (ii) that obtained by the exhaustive Soxhlet extraction of a shock-carbonized coking coal with chloroform.

The extracts were applied to $\frac{5}{8}$-in. outside diameter cupro-nickel condenser tubes as 1 per cent solutions in Sextone *B*. The method of application varied, either painting, dipping or electrophoretic deposition being used ; after applying the coatings, the tubes were drained and then baked at about 240° C. for 30 min.

These treated tubes were then placed in a single-tube test condenser condensing up to 200 lb. steam/hr./sq. ft. condensing surface and assessed by visual observation of the mode of condensation and also by measurements of the overall heat transfer. Fig. 1 shows an untreated tube on which the steam condensed as a film and Fig. 2 a treated tube upon which the steam condensed in the form of drops ; the overall heat transfer with the latter was 55 per cent higher than with the former (at a water velocity of 13 ft./sec.).

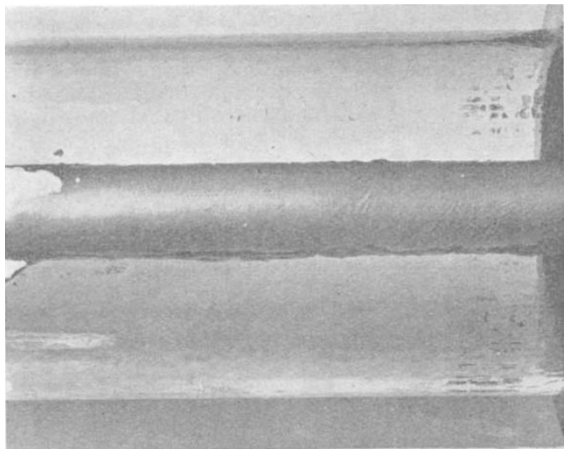

Fig. 1. Filmwise condensation

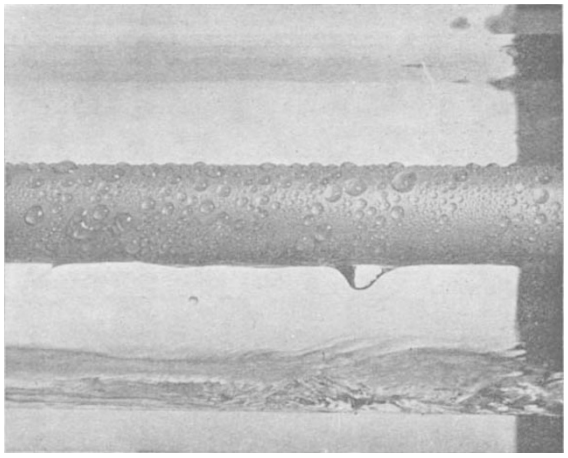

Fig. 2. Dropwise condensation

Tests have shown that the endurance of these promoters is markedly better than that of many other promoters that have been tried. Further tests are in progress.

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[1] Dryden, I. G. C., *Fuel*, **30**, 39 (1951).
[2] Dryden, I. G. C., *Fuel*, **31**, 176 (1952).

Critical Temperature for Phase Separation of the Solid Solutions of Rare Gases

THE rare gases argon and krypton form a solid solution at 77° K. that shows a positive deviation from Raoult's law[1]. At this temperature, the tendency toward phase separation may be estimated from the value of the energy of mixing parameter w_{AB}/kT of about 1·3. This value was estimated by the use of the crude treatment of regular solutions[2] on data taken in an apparatus not primarily designed for the task.

We have now made refined measurements in an accurately thermostated copper block fitted with a capsule-type platinum-resistance thermometer, and connected to a sensitive manometer. The measurements have been made on mixtures of krypton and xenon, because for this system the region of interest lies in the temperatures immediately above the boiling point of nitrogen. The total pressure at six temperatures was determined as a function of mole fraction, and the results at each temperature were fitted to the quasi-chemical theory of regular solutions[3]. The w_{AB} values so obtained were a linear function of temperature, and extended roughly to the critical value of the temperature, which was thereby estimated to be $90{\cdot}2 \pm 2{\cdot}0°$ K.