Pyrometry in the Non-Ferrous Foundry

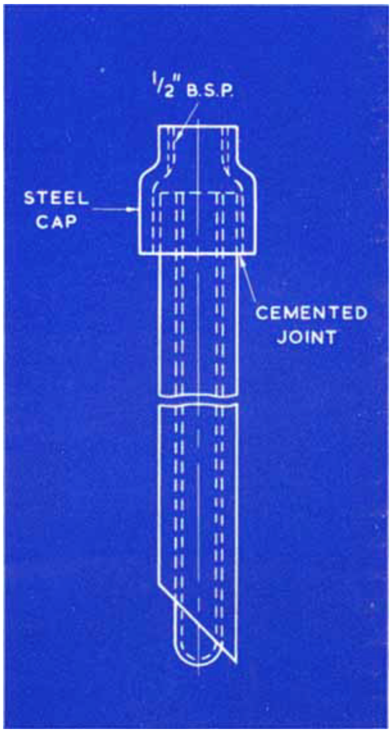
PLATINUM THERMOCOUPLES IN THE CONTROL OF MELTING OPERATIONS

The importance of controlling pouring temperatures, not only in achieving soundness and in meeting tight specifications, but also in economising in fuel and refractories, is generally accepted by the foundryman. Many non-ferrous foundries are not yet, however, fully equipped with instruments designed for the control of their melting operations, and although this may be due in some degree to the lack of encouragement given to the instrument manufacturer, there is no doubt that satisfactory types of pyrometers and other equipment are available and that their use can be of real value. A detailed review of this problem, and of the factors governing the choice, installation and maintenance of foundry instruments, was presented at the annual conference of the Institute of British Foundrymen, held at Buxton in May, by D. W. Brown, of the Morgan Crucible Company Ltd., under the title "Instrumentation for the Melting of Non-Ferrous Metals" (*Brit. Foundryman*, 1958, **51**, (3), 128).

In the steel-making industry the full and very real advantages of immersion pyrometry have been achieved by recognising the need for proper care and maintenance of the thermocouple. As Mr. Brown explains early in his paper, a similar acceptance of this essential factor is required in the foundry if equally valuable results are to be obtained. The instruments should be designed so that the thermocouple and its protective tube can be easily changed, and one man should be made responsible for ensuring that the equipment is in working order. Given this simple form of respect, thermocouple pyrometers will give consistent and reliable service and appreciably greater accuracy than can be obtained with optical pyrometers.

The two major considerations then remaining are the choice of base metal or noble metal couples, and the provision of a sheath combining adequate protection with reasonable speed of response.

The chromium-nickel : aluminium-nickel couple is used to an appreciable extent in the



A composite thermocouple protection tube for continuous immersion. The thin inner tube is of Impervious mullite, sealed into a stout open-ended silicon carbide outer tube melting and casting of non-ferrous alloys, but its accuracy and life fall off at temperatures above 1100°C. The platinum : rhodium-platinum couple, on the other hand, can be used to give accurate readings up to temperatures of about 1650°C, and although care is necessary to avoid contamination its great reliability, together with its high scrap value, have led to its increasing use not only in the higher temperature range but in the casting of bronzes and other copper alloys at around 1100 to 1200°C. With a properly designed thermocouple it is usually possible to obtain a life of between 50 and 100 dip readings; a new junction can then be made in a few minutes with the removal of only about half an inch of contaminated platinum wire.

The disadvantages of the bare-wire method and of heat-resisting metal protection tubes are described in the paper and the author then goes on to discuss ceramic tubes (both simple and composite), electrographite and the newer metal-ceramic tubes. For dip readings ceramic tubes are insufficiently resistant to thermal shock, but they are probably the best available for continuous immersion. A recommended design of composite sheath comprising a thin inner tube of impervious mullite sealed into a stout open-ended silicon carbide to provide strength is shown in the diagram.

Electrographite withstands thermal shock, is unaffected by molten metals and slags and is reasonably strong. It does not give long life when continuously immersed, but is very useful for dip-immersions up to 1600°C or over, giving a reading in 25 to 40 seconds, with a life of between 40 and 100 dips.

Metal ceramic tubes—in combinations such as chromium-alumina and molybdenum-alumina—show considerable promise as "the pyrometer tube of the future", but at present are still in course of development. They have been used successfully for both dip and continuous readings in copper and nickel alloys, but at their present cost are probably not economical for dip readings by comparison with electrographite tubes.

In the conclusion to his paper, Mr. Brown emphasises that the problem of instrumentation in the non-ferrous foundry is becoming urgent as skilled labour is more difficult to obtain, so that control of operations must be taken out of the hands of the man and built into the melting plant.

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Petroleum Reforming Research in the USSR

The use of a platinum on silica gel catalyst for reforming a naphtha fraction has been studied by a group of chemical engineers working at the Division of Chemical Sciences of the USSR Academy of Science (*Izv. Akad. Nauk USSR*, 1957, **10**, 1223–1228).

The catalyst had a platinum concentration of 0.5 per cent and was prepared by impregnating silica gel with a solution of chlorplatinic acid. The particle size range of the gel was 1.5 to 2.5 mm. The hydrocarbons in the naphtha fraction had a boiling range from 96 to 114°C and were, by volume, 55 per cent paraffinic, 39 per cent naphthenic and 6 per cent aromatic. The apparatus was of conventional design with an electrically-heated stainless steel reactor. It was arranged for gas-recirculation and was suitable for operation at pressures up to 50 atm.

The effects of pressure, hydrogen/hydrocarbon ratio, space velocity and temperature on the yield and composition of the product were studied. Altering the gas ratio had little effect, increasing the pressure and the space velocity diminished the yield of aromatics, while raising the temperature increased the aromatic hydrocarbon content. The optimum combination of conditions for the maximum production of aromatic hydrocarbons was established. The catalyst was an effective dehydrogenating agent, the aromatics coming chiefly from dehydrogenation of naphthenes.