EXPERIENCE WITH MULTIPLE IMPURITIES DETECTED BY PLUGGING INDICATORS IN SODIUM SYSTEMS

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INTRODUCTION

Plugging indicators are rugged instruments which have been widely used to monitor the impurity levels of reactor sodium circuits and other sodium test loops. Their main advantage lies in that they give direct information concerning the plugging of flow passages in terms of what is called plugging temperature.

These instruments suffer from one draw back in that their response is non-specific. However, they are sufficiently sensitive to indicate presence of multiple impurities in sodium. In this paper, the authors have discussed their experience with multiple impurities detected by plugging indicators. Attempts have also been made to identify the nature of these impurities by studying their precipitation kinetics and its comparison with published literature.

DESCRIPTION OF SODIUM SYSTEMS AND PLUGGING INDICATORS

The impurity behaviour discussed here was studied in two different sodium systems in which commercial grade sodium was charged through microfilters. Sodium charged in the two systems was obtained from two separate suppliers. Plugging indicator-A (PI-A) (Fig. 1) was installed on the system A containing 2.75 tonnes of sodium and indicator-B (PI-B) was installed on the system B containing 1.3 tonnes of metal. These systems were primarily meant for studies of performance of components such as sodium-sodium heat exchanger, sodium pump and control rod drive mechanisms. The flow restrictions in PI-A consists of 12 sq.holes of 1 x 1 mm and those in PI-B consists of 16 holes of 1 mm dia. Both plugging
indicators were operated in the manual mode, wherein, the cooling rate was controlled manually by adjusting the air flow rate.

![Diagram](image)

Fig. 1. Plugging indicator

DETECTION OF MULTIPLE IMPURITIES

The behaviour of multiple impurities in a sodium system is complex in nature. The effects are more predominant during the initial purification of sodium before the system is in equilibrium with cold trap. It is, however, quite difficult to know the exact identity of impurities unless one is equipped with instrument for continuous monitoring of specific impurity. Smith et al. have recently studied impurity behaviour in the plugging indicator using electrochemical monitors (1). In our sodium systems both plugging indicators PI-A and PI-B have detected multiple impurities. However, the nature of impurities detected in the two systems appears to be different. This is discussed below.

EXPERIENCE WITH PI-A

Plugging indicator-A detected two impurities having plugging temperatures of 340 °C and 165 °C (2). The first impurity\(^x\) causing plugging around 340 °C showed a few important characteristics. The impurity could be removed by gradually reducing the cold point temperature of the cold trap. However, after a few hours of cold trapping at 270 °C, a new plugging run could not establish plugging temperature in the expected temperature range close to the cold point temperature. On the other hand plugging occurred at a much lower temperature of about 165 °C, indicating that the impurity plugging at higher temperature did not cause plugging below 270 °C. This indicated clearly that the first impurity has a very low solubility below 270 °C.

\(^x\)Throughout the discussion, the first impurity refers to the one plugging at higher temperature and the second corresponding to lower temperature.