Quantitative Phase Analysis of XRD Data of Sludge Deposits from Refineries and Gas Plants by Use of the Rietveld Method

Husin Sitepu and Rasha A. Al-Ghamdi
Research & Development Center, Saudi Aramco, P.O. Box 62, Dhahran, Saudi Arabia

ABSTRACT

The sludge deposits that frequently accumulate inside the equipment used in the oil industry can cause failures and temporarily shut down the refinery and gas plants. Recently, Sitepu and Zaidi (2017) described a new method to separate the inorganic materials (i.e., non-hydrocarbon part) from the hydrocarbon (dichloromethane soluble part) of the sludge deposits that were collected from the diesel oil tank in a refinery. Also, they accurately identified the phase identification of X-ray powder diffraction (XRD) data of inorganic materials, and quantitatively calculated the weight percentage for each of the identified phases. They indicated that the method is fast and can accurately identify very small quantities of inorganic materials present in the sludge deposits. Additionally, gas chromatography mass spectrometry analyses results revealed that the type of hydrocarbon was diesel with the C10–C27, suggesting the minor portion of the oil-based type of the sludge deposits was a diesel.

In this paper, the method developed by Sitepu and Zaidi (2017) has been extended to characterize the as-received sludge samples collected from: (i) a regeneration overhead acid gas condenser, (ii) water draw off pump's suction strainer in a gas plant, and (iii) inside the vessel's equipment of the sulfur recovery unit (SRU). The results revealed that the major phases are: (i) iron sulfide corrosion product with the hydrocarbon type of mixture of diesel and lube oil for sludge deposits from a condenser, (ii) calcium carbonate with the hydrocarbon type of lubricant oil for sludge deposits from a suction strainer for pumps, and barium sulfate with no organic hydrocarbon or polymer for sludge samples from a water recycling pump.

Moreover, the major phases for inorganic materials from different locations inside the vessel's equipment of the SRU revealed that iron oxide corrosion products are found in the steam drum, and iron sulfate corrosion products are built up in the condenser. The presence of dissolved oxygen in the boiler feed water is indicated by a high weight percentage of iron oxide corrosion product in the form of magnetite (Fe_3O_4), which appeared in the deposits collected from the steam drum. Knowing accurately which phases and its weight percentages were involved in the inorganic materials (non-soluble part) of the sludge deposits along with the type of hydrocarbon soluble part, can guide the field engineers at the refinery and gas plants to facilitate efficient cleaning of the equipment by drawing up the right procedures and taking preventive action to stop the generation of those particular sludge deposits.

REFERENCES:

Sitepu, H. and Zaidi, S.R. (2017): "Application of a New Method in Identifying the Sludge Deposits from Refineries and Gas Plants: A Case of Laboratory-Based Study," *International Journal of Corrosion*, Vol. 2017, Article ID 9047545, 7 p., https://doi.org/10.1155/2017/9047545.