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QUANTITATIVE RIETVELD PHASE ANALYSIS OF SCALE AND CORROSION PRODUCTSFORMED INSIDE OIL AND GAS INDUSTRY EQUIPMENT: AN IMPORTANT INDUSTRIAL CHALLENGE

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ABSTRACT

Scale and corrosion deposits — that accumulate inside oil industry equipment — can cause failures and temporarily shut down refineries and gas plants. Recently, Sitepu and Al-Ghamdi (2019); and Al-Ghamdi and Sitepu (2018) described a new method to separate the nonhydrocarbon part (i.e., crystalline inorganic materials) from the hydrocarbon part (i.e.,dichloromethane soluble) of the sludge deposits. Also, they quickly and accurately identified the phase identification of X-ray powder diffraction (XRD) data of small amounts of crystalline inorganic materials and performed quantitative Rietveld Phase Analysis foreach of the identified phases. The method is fast and can accurately identify very small quantities of inorganic materials present in the sludge deposits.

This paper reports the application of the quantitative Rietveld phase analysis of corrosion and scale products which is certainly an important and industrial application, and a challenge educational paper on the analysis of such deposits is worthwhile. The basic premise of this paper — that preferred orientation can affect the results of quantitative analysis — is important, and worth discussing. Examples of quantitative Rietveld phase analysis of (i) synthetic mixtures of drilling mud in the form of barium sulfate with the mineral name barite ($BaSO_4$), formation material in the form of silicon oxide mineral name quartz (SiO_2) and iron oxide mineral name hematite (Fe_2O_3); (ii) the unknown natural corrosion products from the high-pressure boiler condensate storage and feed water deaerator; and (iii) structure and texture characterization of calcium carbonate scale in the form of calcite ($CaCO_3$).Key information is quantitative Rietveld phase analysis, the lattice parameters (which can reflect composition) and information derived from the XRD profile parameters and the preferred crystallographic orientation. All aspects of the microstructure are worth discussing. Iron oxide in the forms of magnetite, goethite, hematite, and lepidocrocite are especially prone to preferred orientation, and so would be worth including in the samples discussed. The quantitative Rietveld phase analysis for all of the XRD data sets revealed that the findings can quickly and accurately guide the field engineers at the refinery and gas plants, to facilitate efficient cleaning of the equipment by drawing up the right procedures, and take preventive action to stop the generation of those particular sludge deposits.

KEYWORDS: *Quantitative Rietveld Phase Analysis, Structural and Texture Refinement, Scale and Corrosion Deposits*