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Chemical characterization of coke fouling from pipeline, refinery and upgrader process units

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The build-up of undesirable materials on the surfaces of process units and heat exchangers, known as fouling, involves the deposition of solid or semi-solid chemical species present in the fluid that passes through the equipment, or the formation of chemical reaction products on the equipment surface. Coke fouling, a combination of these two fouling processes occurs in much of the equipment utilized throughout the industrial energy sector. Coke deposit composition is a complex element. Though, in general, coke is defined as carbonaceous material, this definition falls short in terms of the fouling process. The chemical and physical properties of the coke are highly dependent of the degree of hydrogen and oxygen inclusion, as well as the presence of heavy metals such as iron, vanadium, nickel and manganese. Over 60 different coke fouling samples, collected from various different refineries, upgraders and pipelines, were analyzed and found to have rather large variations in chemical composition and physical properties. Utilizing this information, a picture of coke fouling as a chemical spectrum begins to emerge, providing avenues for new and more effective methods for removing what continues to remain one of the largest fouling problems within the industry.

Figure.1: Different physical forms of high carbon content coke include shot coke, sponge coke, honeycomb coke, needle coke and coke fines. Coke can be 'green' or unprocessed, calcined, uncalcined, fuel grade, metallurgical grade or anode grade. Foulant Coke may be any one or a combination of these, with varying levels of purity.

Biography

Shank Roxanne A obtained her BSc in Biochemistry in 2010 from the University of Lethbridge (UofL). She went on to do her M.Sc. in Biochemistry specializing in Nuclear Magnetic Resonance (NMR) Spectroscopy through the UofL. Her background in chemical instrumentation expanded when she joined the Clean Harbors Research and Development team in 2011 where she began researching fouling deposits and formulating chemical blends for use in industrial chemical cleaning applications. She was granted the designation of Professional Chemist in 2016 from the Association of the Chemical Profession of Alberta (ACPA). Among her scholarly endeavors, she acts as Chair for the Specific Task Group (STG 06) Chemical and Mechanical Cleaning through NACE International and runs a biennial symposium on the advancements in Chemical Cleaning of Industrial Equipment. She is currently pursuing a Higher National Certificate (HNC) in Process Engineering through Teesside University.

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