

Characterization of iron and cobalt based catalysts after aquathermolysis processes by mössbauer spectroscopy

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Abstract

© SGEM2018. Heavy crude oils are extracted mostly by thermal recovery methods which reduce viscosity of heavy oil due to destruction of associative bonds in a complex oil fluid. In a number of articles, it is proved that at a temperature of more than 200-250° C there is also a certain chemical transformation of hydrocarbons, primarily containing hetero-elements. The use of finely-dispersed catalysts, injected directly into the oil-bearing formation, allows to intensify the processes of destructive hydrogenation of asphaltenes and resins during steam-heating treatment. The efficiency of various catalysts based on transition metals for the reactions of low-temperature cracking, hydrolysis and hydrogenolysis are well known. However, there is no clear understanding of the relationship between the nature of the catalyst and the activity of the transformation of asphalt-resinous compounds in reservoir conditions. The formation of the active form of the catalyst from the oil-soluble precursor has been studied to a small extent. In the work, samples of catalysts, extracted from the oil after laboratory modeling of aquathermolysis, were investigated. The precursors of the catalysts are iron and cobalt carboxylates. ^{57}Fe Mössbauer absorption spectroscopy studies have been performed in zero magnetic field at room temperature to characterize the phase composition of the resulting mixed oxides. Mössbauer spectrum representing a spectrum characteristic of CoFe_2O_4 cobalt ferrite with spinel structure. At room temperature, a clear magnetic pattern is observed with no singlet or doublet contribution. The highest velocity peak shows a clear asymmetry that strongly suggests that, at least, it involves two different components. An analysis of the Mössbauer spectra made it possible to estimate the population of cationic positions in iron-cobalt spinel and Co:Fe ratio. Proportion of the nanosized ferrite was evaluated from Mössbauer measurements at low temperatures. Relation of nature and state of the catalytically active metal and the transformation of asphalt-resinous compounds in reservoir conditions is also discussed.

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Keywords

Aquathermolysis, Catalyst, Mössbauer spectroscopy

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