World Academy of Science, Engineering and Technology
International Journal of Aerospace and Mechanical Engineering
Vol:9, No:11, 2015

Physico-Mechanical Behavior of Indian Oil Shales

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Abstract : The search for alternative energy sources to petroleum has increased these days because of increase in need and depletion of petroleum reserves. Therefore the importance of oil shales as an economically viable substitute has increased many folds in last 20 years. The technologies like hydro-fracturing have opened the field of oil extraction from these unconventional rocks. Oil shale is a compact laminated rock of sedimentary origin containing organic matter known as kerogen which yields oil when distilled. Oil shales are formed from the contemporaneous deposition of fine grained mineral debris and organic degradation products derived from the breakdown of biota. Conditions required for the formation of oil shales include abundant organic productivity, early development of anaerobic conditions, and a lack of destructive organisms. These rocks are not gown through the high temperature and high pressure conditions in Mother Nature. The most common approach for oil extraction is drastically breaking the bond of the organics which involves retorting process. The two approaches for retorting are surface retorting and in-situ processing. The most environmental friendly approach for extraction is In-situ processing. The three steps involved in this process are fracturing, injection to achieve communication, and fluid migration at the underground location. Upon heating (retorting) oil shale at temperatures in the range of 300 to 400°C, the kerogen decomposes into oil, gas and residual carbon in a process referred to as pyrolysis. Therefore it is very important to understand the physico-mechenical behavior of such rocks, to improve the technology for in-situ extraction. It is clear from the past research and the physical observations that these rocks will behave as an anisotropic rock so it is very important to understand the mechanical behavior under high pressure at different orientation angles for the economical use of these resources. By knowing the engineering behavior under above conditions will allow us to simulate the deep ground retorting conditions numerically and experimentally. Many researchers have investigate the effect of organic content on the engineering behavior of oil shale but the coupled effect of organic and inorganic matrix is yet to be analyzed. The favourable characteristics of Assam coal for conversion to liquid fuels have been known for a long time. Studies have indicated that these coals and carbonaceous shale constitute the principal source rocks that have generated the hydrocarbons produced from the region. Rock cores of the representative samples are collected by performing on site drilling, as coring in laboratory is very difficult due to its highly anisotropic nature. Different tests are performed to understand the petrology of these samples, further the chemical analyses are also done to exactly quantify the organic content in these rocks. The mechanical properties of these rocks are investigated by considering different anisotropic angles. Now the results obtained from petrology and chemical analysis are correlated with the mechanical properties. These properties and correlations will further help in increasing the producibility of these rocks. It is well established that the organic content is negatively correlated to tensile strength, compressive strength and modulus of elasticity.

Keywords : oil shale, producibility, hydro-fracturing, kerogen, petrology, mechanical behavior
Conference Title : ICAMAME 2015 : International Conference on Aerospace, Mechanical, Automotive and Materials Engineering
Conference Location : Cape Town, South Africa
Conference Dates : November 05-06, 2015