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Physical and thermal properties of Jordanian tar sand

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Abstract: A preliminary characterization and beneficiation study of Jordanian tar sand obtained from the Dead Sea area has been carried out. Representative tar sand samples were crushed using a jaw crusher and sieved to different size fractions. Characterization of these size fractions revealed that most of the bitumen content was concentrated in the smallest size fraction ($< 106 \mu\text{m}$). Scanning electron microscopy images showed that the structure of the tar sand is composed of quartz particles of $< 1 \text{ mm}$ in size surrounded by a bitumen containing envelope which can be regarded as a binder. The pyrolysis kinetics of the material was studied using thermogravimetric analysis (TGA) and the relationship with heating rate was derived. The mass loss obtained from TGA was found to be independent of the heating rate at 35% of the original mass. Three regions of differing kinetic parameters were identified during pyrolysis; a low temperature pyrolysis region, a fuel deposition region and a high temperature pyrolysis region. It was found that the activation energy, in the region of fuel deposition, changes from 32 kJ/mol to 42 kJ/mol by increasing the heating rate from 1 $^{\circ}\text{C}/\text{min}$ to 50 $^{\circ}\text{C}/\text{min}$, respectively.