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# Deformational characteristics of thermally treated sandstone from an underground coalmine fire region, India

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The Jharia region of lower Gondwana in India is one of the largest Underground Coalmine Fires (UCF) affected coalfield in the world. The UCF induced small scale as well as large-scale surface fracturing often creates the life-threatening conditions to coal miners and local surroundings. So, there is a need to understand the thermomechanical behaviour of coal measures rocks to predict the land disturbances in thermo-environmental conditions. It will provide an insight into the UCF induced subsidence mechanism and its preventive measures. The Jharia coal field predominantly consists of sandstone (75-80% by volume) and rest is composed of coal, shale and carbonaceous shale. The present study focuses on thermo-mechanical behaviour of Barakar sandstone (BS) under elevated temperatures. The cores of BS sample were prepared according to the ISRM standards. Further, samples were grouped and thermally treated in temperature range of 25°C, 100°C, 150°C, 300°C, 400°C, 500°C, 600 °C, 700°C and 800°C at a heating rate of 5°C/min for 24 hours in furnace. Then, these thermally treated BS samples were subjected to laboratory test for stress-strain characteristics. In the process of deformational characteristics evaluation, effect of mineralogical changes and mode of fracture pattern were also studied at the mentioned elevated temperature. Based on the obtained results, the deformational behaviour of thermally treated BS specimens can be grouped into three zones, viz., zone 1 (25-300°C), zone 2 (300-500°C) and zone 3 (500-800°C). In zone 1, the characteristics of the stress-strain curve is similar to those under air dried sandstone specimen. However, small increment in stiffness were observed upto 300°C. The stress-strain curves in this zone shows dominantly brittle fracturing. The increment in stiffness may be related to evaporation of pore water that increases the cohesion between the mineral grains resulting higher stiffness value. In zone 2, the deformation pattern again shows brittle fracturing with continuous decrement in stiffness. The reduction in stiffness may be related to thermally induced porosity and increased microcrack density. In zone 3, the stress strain curve is observed to be concave upward. It indicates the pseudo-ductile behaviour of the thermally treated BS specimens. The observed results suggest a typical behaviour of deformation pattern under UCF induced rock fracturing which may be useful in predicting the land subsidence in UCF affected areas. Present research outcome may be used to design the support measures to reduce the associated hazards.