

Petrographic and geo-mechanical investigation of diorite rocks from district Bajaur, North West Pakistan

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Common igneous rocks such as granite and diorite are widely used as building materials and dimensional stones. The granite-diorite deposits in Pakistan are estimated to be 297 billion tons of various colors and textures. Six samples of diorite from the Pashat area of district Bajaur, NW Pakistan were examined for petrographic and physico-mechanical parameters.

Petrographic investigation revealed that all samples are mega porphyritic. The rocks contained varying amounts of dominant mineral phases like plagioclase, quartz, amphibole while biotite, muscovite, chlorite, and opaque ore grains constitute the minor phases. Rocks are mostly composed of plagioclase (60%), quartz (14%), amphibole (13%) and biotite (10%), along with chlorite (1%) and opaque (2%). Polysynthetic twinning and undulose extinction are commonly observed in plagioclase and quartz grains respectively. Some euhedral to subhedral plagioclase grains exhibit worm-like intergrowths of quartz resulting in a myrmecitic texture. Amphibole phenocrysts are dominant in the matrix of quartz and plagioclase feldspar with an average abundance of 11%. At places, these phenocrysts show dominant chlorite alteration and are fractured.

The coarse grain texture and no significant alteration in the studied samples have a positive effect on rocks mechanical properties. Following a comprehensive petrographic analysis, their uniaxial compressive and uniaxial tensile tests (UCS, UTS) as well as their physical properties (porosity, water absorption and specific gravity) were determined. The values obtained for unconfined compressive strength (UCS) ranging from 40.4 to 97.9 MPa, unconfined tensile strength (UTS) ranging from 5.03 to 10.10 MPa, water absorption ranging from 0.04 to 0.76%, porosity ranging from 0.01 to 2.28% and specific gravity ranging from 2.871 to 2.893%. Based on UCS-derived and UTS-derived parameters, the studied rocks fall into the category of moderate to strong suggesting its suitability for using as dimension stone. Besides this, these rocks are more durable largely attributed to their low water absorption and porosity values. Based on both petrographic and physio-mechanical data, Pashat diorites rocks in the studied area are suitable for building stone, decorative stone. However, they can't be used as an aggregate because of more than 5% strained/undulose quartz which makes them susceptible to alkali-silica reactivity and must be considered before using in high performance concrete.

Keywords: Diorite; Bajaur; UCS; UTS