The specific objectives of the research are to

1. determine the physical (hardness, density, specific density and geomechanical properties (Uniaxial Compressive Strength (UCS); triaxial strength, point load index, Aggregate Crushing Value (ACV); brittleness, Sonic Wave Velocity, Dynamic Young’s Modulus, Dynamic Shear Modulus and Poisson’s Ratio) of the rocks;
2. determine the drill rate index of the rocks,
3. predict the drillability of the selected rock types using Artificial Neural Network (ANN).

**Table 1: Summary of Geomechanical and Physical properties of the different rock samples.**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Location** | **Schmidt Hardness** | **Compressive Strength (MPa)** | **Aggregate Crushing Value (%)** | **Specific Gravity** | **Water Absorption (%)** | **Point Load (MPa)** | **Brittleness Value (%)** | **Siever J (SJ) Value (mm)** | **Density (g/cm3)** |
| C G | 45 | 88.6 | 29.4 | 2.631 | 0.40 | 4.68 | 78.23 | 0.70 | 2.661 |
| KM | 49 | 101.3 | 27.8 | 2.661 | 0.34 | 5.92 | 63.71 | 0.67 | 2.710 |
| LG | 45 | 59.0 | 37.5 | 2.617 | 0.44 | 4.66 | 81.54 | 0.70 | 2.629 |
| GAR | 50 | 112.7 | 26.1 | 2.663 | 0.30 | 6.56 | 61.37 | 0.63 | 2.734 |
| KE | 54 | 174.4 | 20.2 | 2.720 | 0.10 | 7.04 | 34.43 | 0.58 | 2.863 |
| NE | 49 | 92.58 | 28.4 | 2.641 | 0.38 | 4.97 | 68.52 | 0.67 | 2.685 |
| GAW | 49 | 96.1 | 28.25 | 2.649 | 0.33 | 5.60 | 64.12 | 0.67 | 2.694 |
| KW | 51 | 121.42 | 25.3 | 2.691 | 0.27 | 6.70 | 55.41 | 0.62 | 2.758 |
| MA | 52 | 126.6 | 24.0 | 2.692 | 0.25 | 6.97 | 49.78 | 0.60 | 2.831 |

**Table 1: (Continued) Summary of Geomechanical and Physical properties of the different rock samples.**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Location** | **Dynamic Young Modulus** | **Dynamic Shear Modulus** | ***P* – Wave Velocity (m/s)** | ***S* – Wave Velocity (m/s)** | **Poission’s Ratio (V)** | **Rock Hardness (*f*)** | **Drilling Rate Index (DRI)** | **Drillability Characterization based on Rock Hardness (*f*)** | **Drillability Characterization based on DRI** |
| C G | 25.0 | 10.3 | 3251 | 1969 | 0.21 | 8.8 | 61 | Rather Hard | High |
| KM | 37.4 | 14.9 | 4134 | 2371 | 0.25 | 10.1 | 48 | Hard | Medium |
| LG | 16.2 | 7.0 | 2641 | 1637 | 0.19 | 5.9 | 64 | Hard | High |
| GAR | 37.8 | 15.1 | 4146 | 2379 | 0.25 | 11.2 | 43 | Hard | Medium |
| KE | 47.7 | 18.1 | 5045 | 2618 | 0.32 | 17.44 | 20 | Very Hard | Extremely Low |
| NE | 24.9 | 9.7 | 3425 | 1898 | 0.28 | 9.22 | 54 | Very Hard | High |
| GAW | 35.5 | 14.5 | 3866 | 2316 | 0.22 | 9.61 | 50 | Hard | High |
| KW | 42.1 | 16.4 | 4536 | 2486 | 0.29 | 12.12 | 38 | Hard | Medium |
| MA | 41.1 | 15.7 | 4626 | 2442 | 0.31 | 12.66 | 32 | Moderate | Low |

**Table 2: Correlations of Drilling Rate Index with Index Properties**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Location** | **DRI** | **S.H** | **S.G** | **Den** | **UCS** | **PL** | **ACV** | **Br** | **Vp** | **Vs** | **DYM** | **DSM** | **Pratio** | **WA** | **Q%** |
| C G | 61 | 45 | 2.631 | 2.661 | 88.66 | 4.68 | 29.4 | 78.23 | 3251 | 1969 | 25 | 10.3 | 0.21 | 0.40 | 20 |
| KM | 48 | 49 | 2.661 | 2.710 | 101.3 | 5.92 | 27.8 | 63.71 | 4134 | 2371 | 37.4 | 14.9 | 0.25 | 0.34 | 25 |
| LG | 64 | 45 | 2.617 | 2.629 | 59.0 | 4.66 | 37.5 | 81.54 | 2641 | 1637 | 16.7 | 7.0 | 0.19 | 0.44 | 15 |
| GAR | 43 | 50 | 2.663 | 2.734 | 112.7 | 6.56 | 26.1 | 61.37 | 4146 | 2379 | 37.8 | 15.1 | 0.25 | 0.30 | 25 |
| KE | 20 | 49 | 2.720 | 2.863 | 174.4 | 7.04 | 20.2 | 34.43 | 5045 | 2618 | 47.7 | 18.1 | 0.32 | 0.10 | 35 |
| NE | 54 | 54 | 2.641 | 2.685 | 92.58 | 4.97 | 28.4 | 68.52 | 3425 | 1898 | 24.9 | 9.7 | 0.28 | 0.38 | 22 |
| GAW | 50 | 49 | 2.649 | 2.694 | 96.1 | 5.60 | 28.25 | 64.12 | 3866 | 2316 | 35.5 | 14.5 | 0.22 | 0.33 | 24 |
| KW | 38 | 51 | 2.691 | 2.758 | 121.42 | 6.70 | 25.3 | 55.41 | 4536 | 2486 | 42.1 | 16.4 | 0.29 | 0.27 | 26 |
| MA | 32 | 52 | 2.692 | 2.831 | 126.5 | 6.97 | 24.0 | 49.78 | 4626 | 2442 | 41.1 | 15.7 | 0.31 | 0.25 | 30 |