INDUSTRIAL UTILIZATION OF PERMIAN WARGAL LIMESTONE OF DHOKRI AREA, CENTRAL SALT RANGE, PAKISTAN.

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ABSTRACT*: -Wargal Limestone of Permian age is well exposed in Dhokri area, western Salt (Longitude 72° 00′E to 73° 05″ E and Latitude 32° 22′ 30′N to 32° 25′ 20′N). The thickness of Wargal Limestone in this area is m, ten samples were collected for the present study to find out its industrial utilization. Good quality lime is produced with controlled calcination conditions at 1100°C (CaO content is 43.52) while low quality lime is formed at 900°C (CaO content is38.52) by its weight percentage. The apparent porosity of lime is 43.56% while its bulk density is 1.78. The limestone contains concentration of acid insoluble residues 0.396% with a pH value 9.1 and total moisture content 0.337%. The Bulk Specific gravity, apparent Specific gravity and water absorption is 2.71, 2.72 and 0.34% respectively. Production of high quality lime promises its industrial utilization is more suitable in various industries which require high quality lime i.e. steel, plastics, rubber, paper, paints, putty, dentifrices, cosmetics, chemical, glass, food, and pharmaceuticals.*

Key words: - Wargal Limestone, Permian, Bulk Specific gravity, Calcination

INTRODUCTION

The Salt Range is an East-West trending elongated narrow trough mountain belt, bounded on the east by the River Jhelum and on the west by the River Indus. Beyond the River Indus, at Kalabagh, it takes a sharp turn to run almost in a North-South direction. The entire mountainous belt have, therefore, previously been differentiated into the Cis-Indus Salt Range and Trans-Indus Salt Range, now known as The Salt Range and Trans-Indus Surghar Range, respectively [Sameeni, 1]. The Dhokri area is an easily accessible area, lies is the western Salt Range (Longitude 72° 03′ 20 ″ to 73° 05′ 00″ E, Latitude 32° 23′ 50″ to 32° 25′ 20″N) shown in Fig-1.

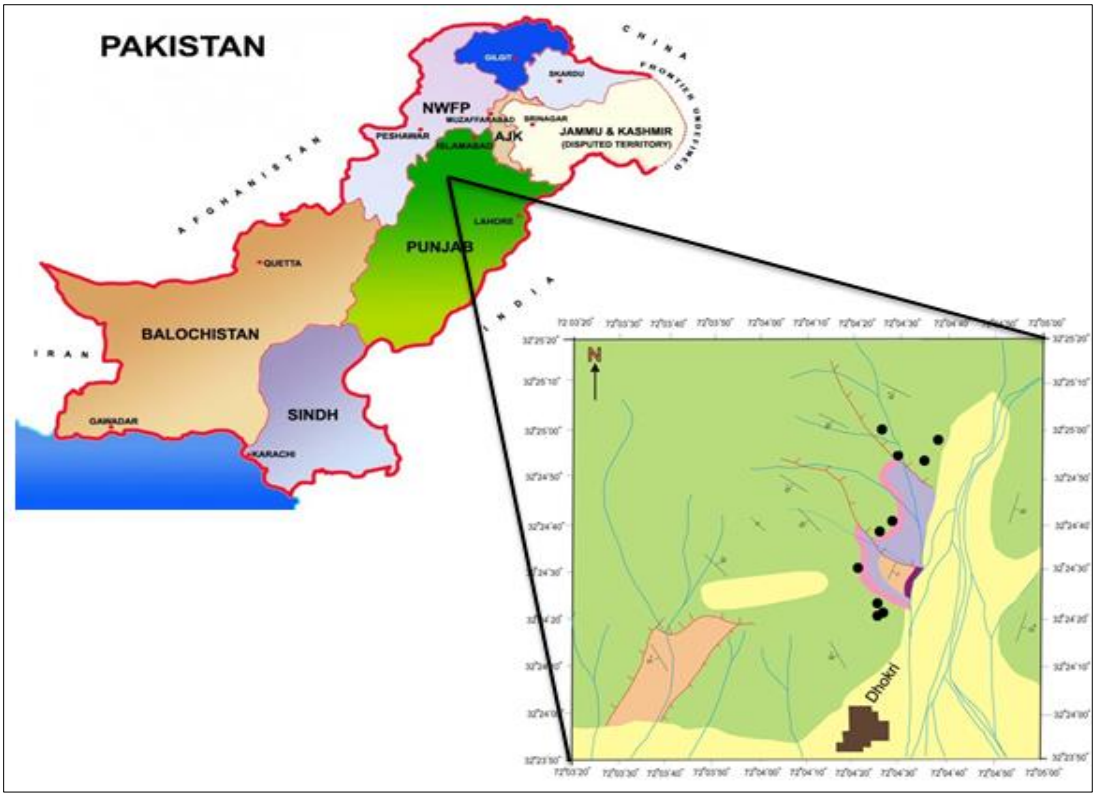

Fig. 1 Location Map showing the study area

In Dhokri area, the exposed rocks are from Pre-Cambrian to Miocene in age. The oldest one is The Salt Range Formation of Pre-Cambrian age while youngest one are Siwaliks Group of Miocene age. The Zaluch Group of Permian age is well exposed amongst which Wargal Limestone has excellent exposures in this area. The Wargal Limestone is meters thick in this area, ten samples were collected for its mineralogical study and labeled as W1-W10. The Wargal Limestone is preponderantly limestone with dolomite. It is light olive and yellowish grey on weathered surface and fresh color is olive grey, mostly medium to thick bedded massive compact and hard to break. A set of jointing and fracture

pattern are randomly distributed. Veins and veinlets of recrystallized calcite are hardly present in whole mass of limestone. Its contact with underlying Amb Formation is sharp and transitional with overlying Chhidru Formation.

Limestone is present at various stratigraphic levels (from Pre-Cambrian to Eocene) in Pakistan. Limestone has many forms and is classified in terms of its origin, chemical, composition, structure and geological formation [Oates, 2]. It occurs widely throughout the world, and as an essential raw material for many industries [Smith, 3]. Calcium carbonate of Limestone is used in wide range of products e.g. steel, plastics, rubber, paper, paints, chemical, glass, food, putty, dentifrices, cosmetics, matches and pharmaceutical [Othmer, 4]. The physical and chemical characteristic of limestone depends on its mineralogical composition, texture, depositional environment and tectonic history.

The virtually inexhaustible deposit of good quality limestone in all the four provinces of Pakistan and a reserve of five billion tonsis available by open pit mining [Ali, 5]. In Pakistan, its production is 8,697,573 metric tons per year while in 2000-2001 its production was 11,783,813 metric tons [6].The aim of this research is to provide the knowledge about the petrography and industrial utilization of Wargal Limestone. The results are described in the context of evaluating this limestone resource.

METHODOLOGY

Samples were analyzed physically and chemically by conventional and instrumental methods. Closely sized (12.5mm-25mm) ten (10) representative samples weighed and were calcinated.

The weight loss, loss on ignition, apparent porosity and bulk density, these are the experimental procedures adopted for the evaluation of burning characteristics of limestone and dolomite.

Calcination: Samples were dried at (±110°C) for 90 minutes and were placed in the desiccator for 5 minutes. Samples were treated in the muffle furnace at different temperature ranging from 900°C to 1100°C for 90 minutes at 50°C intervals. After cooling the samples from desiccator, weighed twice in the electric balance. After that samples were kept in sealed polythene bags and placed into the desiccators to prevent from water absorption and atmospheric water [Harrison 7].

pH Measurements: The procedure is adopted from British Standard [8]. A 10% of (Mass/mass) suspension of the limestone powder in distilled water (i.e. 5 gram of powder dispersed in 50 ml of distilled water) was prepared. The pH value was measured at room temperature using a glass electrode. Before measurement was started, the pH meter was calibrated against the buffer solution with a pH value of 7.

Acid Insoluble Residue: Limestone is remarkably pure with fewer amounts of non-carbonate impurities. Impurities are economically important only if they affect the usefulness of the rock. Five gram of limestone powder is placed in a large beaker. A 10% HCl was added until no further reaction took place. The liquid and residue both placed into the vacuum cup onto a weighed No. 5 filter paper. The acid was washed out through distilled water from filter paper. The filter paper dried and weighed to obtain the weight of remaining. The moisture content might be included by using a filter paper rinsed with acid, washing with distilled water dried followed by being weighed [7].

Calculate the % by weight of acid insoluble residue:

$$\% \text{ by weight acid insoluble residue} = \frac{100 \text{ weight of residue in g}}{\text{weight of oven dried sample in g}}$$

Measurement of Total moisture content, Specific gravity and water absorption: The measurements follow the method described in AASHTO [9] Standards. The procedure adopted for moisture content is AASHTO T225. The specific gravity and water absorption performed through T85 [9] method.

RESULTS & DISCUSSION

The physicochemical properties of Wargal Limestone (Loss of ignition LOI, percentage $CaCO_3$ content, apparent porosity, bulk density, percentage of acid insoluble residues, pH value, total moisture content, specific gravity and water absorption).LOI value determine the purity and quality of lime in a limestone, the results of LOI are given in table 1 and in Fig. 2.The total percentage of $CaCO_3$ content in a limestone is (87.55% - 98.91%) at the temperature range from 900^{o}C -1100^{o}C. The results of total percentage are given in table 2 & Fig 3.The apparent porosity value of lime ranges from 38.23-50.94 shown in Table 3 and Fig. 4. The bulk density value determines the porosity of a sample. The observed value of bulk density (1.61-2.03) is within the standard limit and can be seen in table 3 and Fig. 5. The acid insoluble residue procedure was used to determine the impurities present in limestone, the calculated percentages are from 0.20 to 0.93, these values show that limestone is having less impurities (table 3 and Fig. 6). The average pH value of this limestone is 9.1 (table 3 and Fig. 7). All three tests total moisture content, specific gravity and water absorption are used to evaluate the strength of limestone, total moisture content of Wargal limestone is 0.337, this is calculated average value and shown in table 4 and Fig 8. Specific gravity and water absorption values are 2.722 & 0.346 respectively and are illustrated in table 4 & Fig 9. According to ASTM standards all these three values are within the limits.

Table 1 Temperature and % Weight

Temp(°C)	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	Average
900	35.82	36.21	37.68	38.09	37.82	39.64	39.78	39.95	40.07	40.18	38.52
950	38.72	40.49	40.81	41.30	41.41	39.87	40.75	40.83	41.00	41.23	40.64
1000	41.45	41.61	41.64	41.80	42.00	40.39	40.96	41.27	41.40	41.42	41.39
1050	41.86	42.11	42.57	42.70	43.04	42.00	43.15	43.36	43.51	43.61	42.79
1100	43.26	43.34	43.39	43.44	43.51	43.58	43.61	43.64	43.69	43.78	43.52

Table 2 Temperature and %$CaCO_3$ Content

Temp(°C)	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	Average
900	81.41	82.29	85.64	86.57	85.95	90.09	90.40	90.79	91.06	91.31	87.55
950	88.00	92.02	92.75	93.86	94.11	90.61	92.61	92.80	93.18	93.70	92.36
1000	94.20	94.56	94.64	95.00	95.45	91.79	93.09	93.80	94.09	94.14	94.07
1050	95.14	95.70	96.75	97.05	97.82	95.45	98.15	98.54	98.89	99.11	97.26
1100	98.27	98.50	98.61	98.72	98.89	99.04	99.11	99.18	99.30	99.50	98.91

Table 3 Results of Physicochemical properties of Limestone

Sample No	Bulk Specific Gravity	Water Absorption (%)	Total Moisture Content (%)	Acid Insoluble Residues (%)	pH Value
W1	2.723	0.591	0.59	0.42	9.1
W2	2.704	0.419	0.42	0.30	9.3
W3	2.694	0.380	0.41	0.93	9.1
W4	2.719	0.456	0.39	0.25	9.2
W5	2.704	0.390	0.39	0.59	9.1
W6	2.712	0.387	0.38	0.20	9.1
W7	2.718	0.252	0.20	0.20	9.1
W8	2.705	0.197	0.20	0.39	9.1
W9	2.722	0.200	0.20	0.30	9.3
W10	2.727	0.190	0.19	0.38	9.1
Average Value	2.712	0.346	0.337	0.396	9.1

Table 4 Results of Physicochemical properties of Lime

Sample No	Percentage of Apparent Porosity	Bulk density of lime
W1	38.23	1.61
W2	50.94	2.03
W3	43.12	1.87
W4	46.98	1.87
W5	43.12	1.75
W6	42.91	1.75
W7	43.01	1.75
W8	44.21	1.79
W9	41.70	1.71
W10	41.40	1.71
Average Value	43.56	1.78

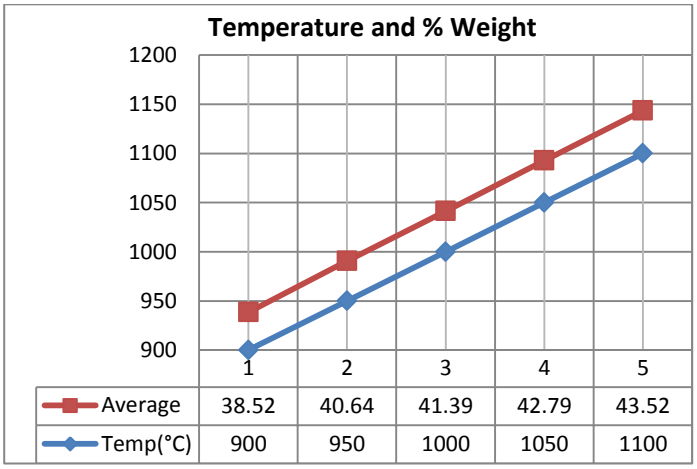

Fig. 2 Graph showing relationship between temperature and weight percentage. (LOI Graph)

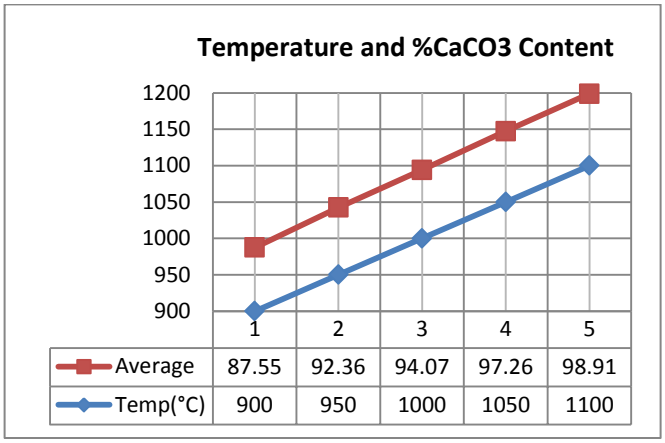

Fig. 3 Graph showing relationship between temperature and CaCO3 percentage

CONCLUSION

The physiochemical analysis of Wargal limestone showed that the maximum CaO content is 43.28 at 1100°C and minimum is 35.82 at 900°C and CaCO3 percentage content is 98.91%. The maximum value of apparent porosity (%) is 43.56 and bulk density and 1.78. The values of acid insoluble residues, pH value, total moisture content and specific gravity are 0.396, 9.1, 0.337 and 2.72 g/cm3 respectively.The values of the test carried out on Wargal Limestone shows that the Wargal Limestone is a limestone og good quality as compared with other limestones The limestone of such high quality is suitable for use in various industries i.e. glass, paper, pottery and cement.

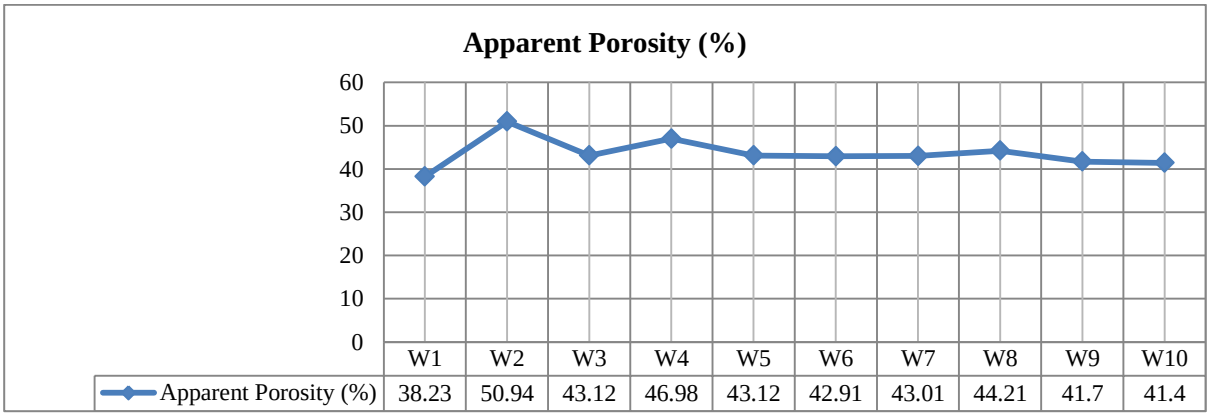

Fig.4 Graph showing Porosity percentage of Lime

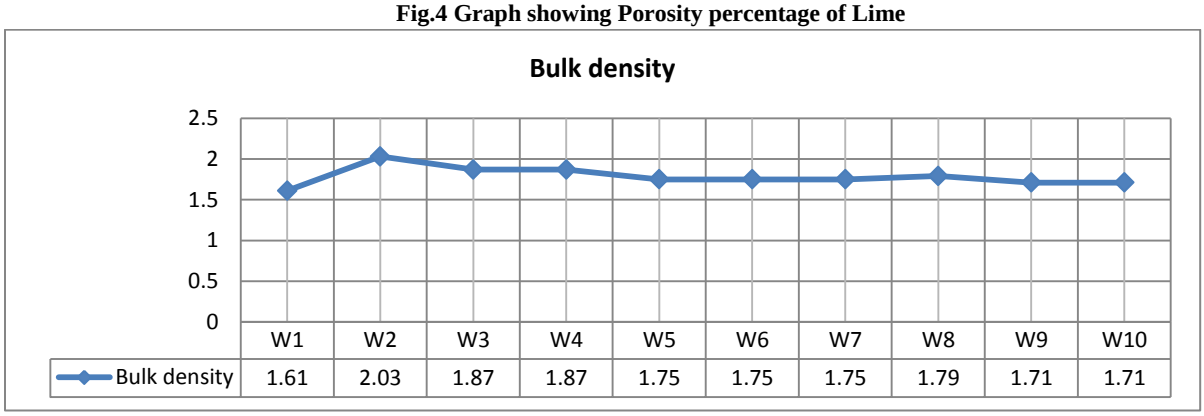

Fig. 5 Graph showing Bulk Density of Lime

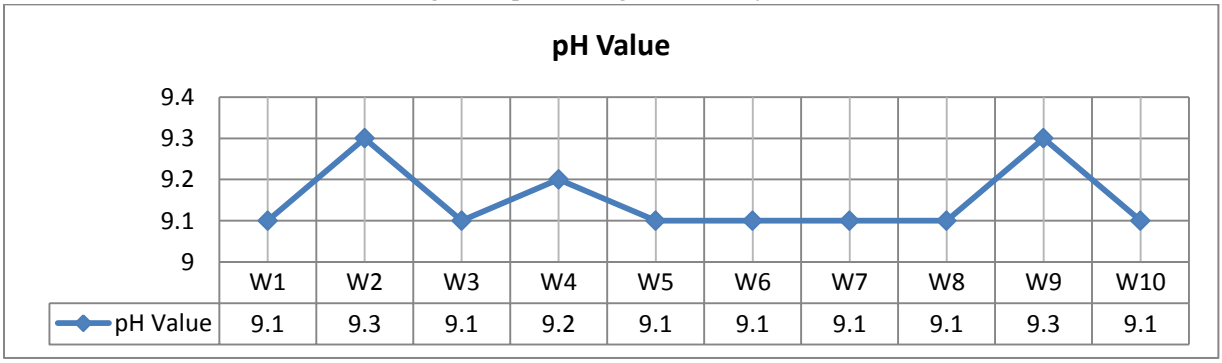

Fig. 6 Graph showing Percentage of acid insoluble residues

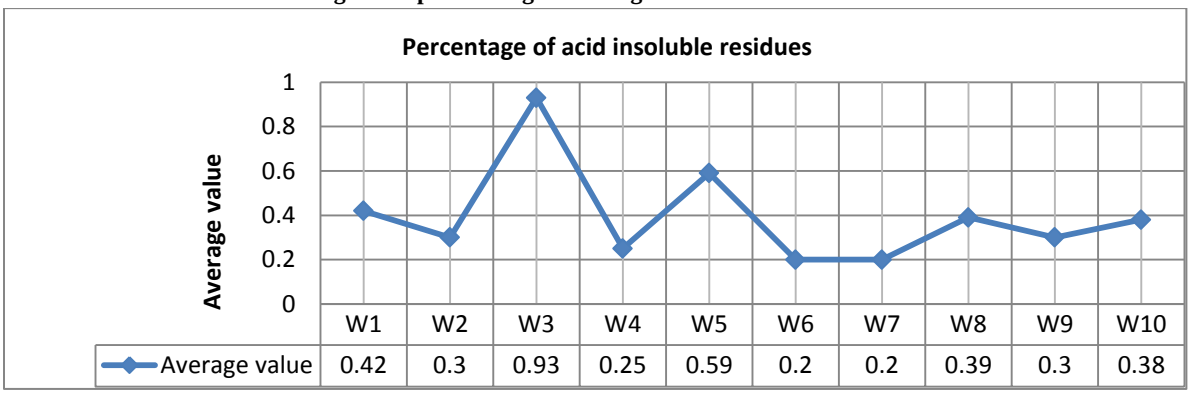

Fig. 7 Graph showing pH value of Limestone

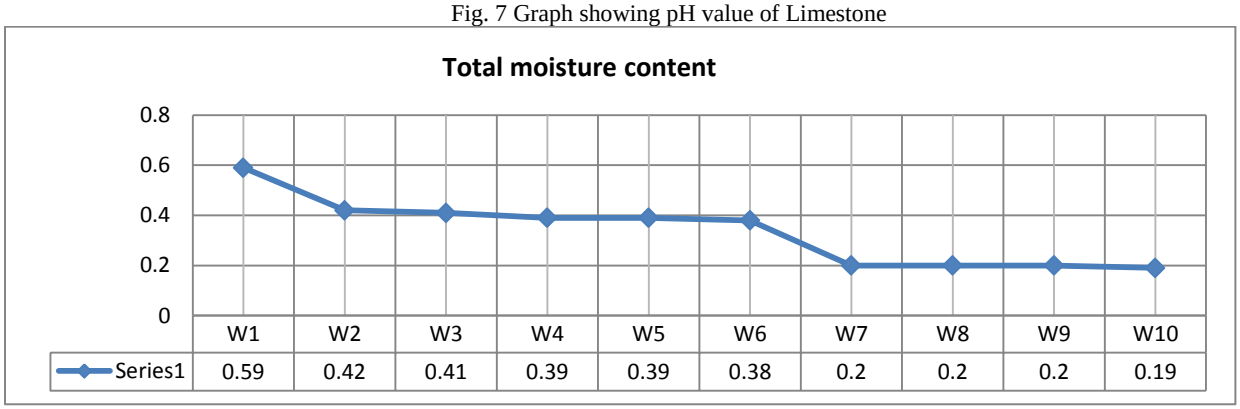

Fig.8 Graph showing Total moisture content

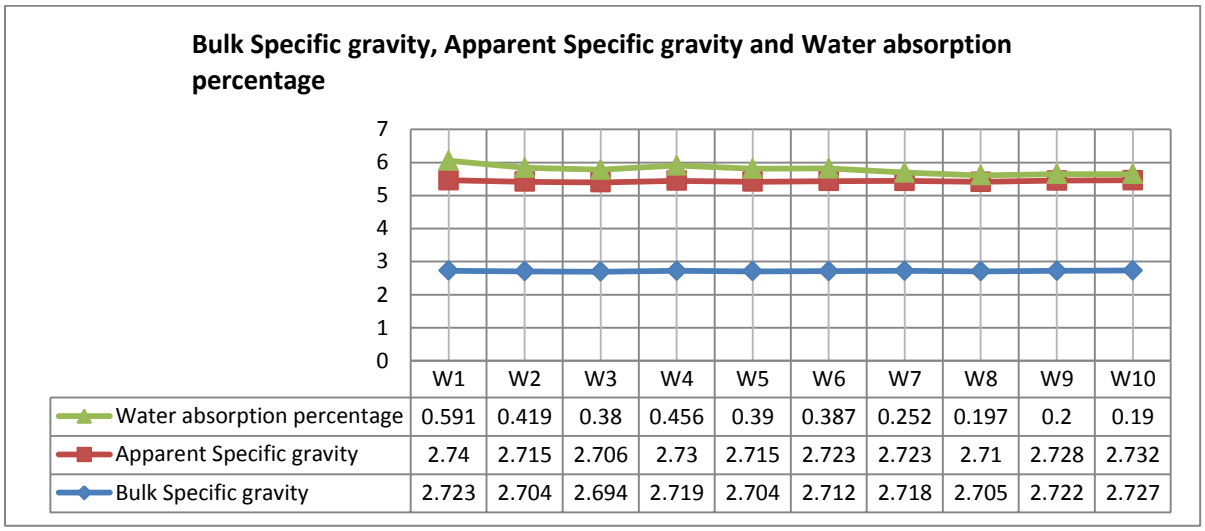

Fig. 9 Graph showing Bulk Specific gravity, Apparent Specific gravity and Water absorption percentage

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