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REQUIREMENTS FOR FILTRATION EQUIPMENT

PART I FILTRATION MEDIA—SAND AND GRAVEL

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PART I FILTRATION MEDIA—SAND AND GRAVEL

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Indian Standard

REQUIREMENTS FOR FILTRATION EQUIPMENT

PART I FILTRATION MEDIA—SAND AND GRAVEL

0. FOREWORD

0.1 This Indian Standard (Part I) was adopted by the Indian Standards Institution on 16 April 1977, after the draft finalized by the Public Health Engineering Equipment Sectional Committee had been approved by the Civil Engineering Division Council.

0.2 Sand and gravel are often employed as filter media for filtration of water. For their proper functioning it is necessary that they should satisfy certain physical and chemical requirements. This standard provides the necessary guidelines in selecting the appropriate type of sand and gravel for filtration. Other media which are also used for filtration of water are not covered under this standard.

0.3 In the formulation of this standard due weightage has been given to international co-ordination among the standards and practices prevailing in different countries in addition to relating it to the practices in the field in this country.

0.4 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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1. SCOPE

1.1 This standard (Part I) lays down the requirements for filter sand and for gravel used in filtration of water.

2. TERMINOLOGY

2.0 For the purpose of this standard, the following definitions shall apply.

*Rules for rounding off numerical values (*revised*).

2.1 Effective Size (E. S.) — Particle diameter corresponding to 10 percent finer on the grain size curve [determined according to IS : 2720 (Part IV)-1975*].

2.2 Uniformity Coefficient — The ratio D60/D10 where D60 is the particle diameter corresponding to 60 percent finer on the grain size curve, and D10 is the particle diameter corresponding to 10 percent finer on the grain size curve.

3. FILTER SAND

3.1 Quality Requirements

3.1.1 Filter sand shall consist of hard, durable grains of silica and shall have a specific gravity of not less than 2·5. All grains of sand shall preferably be water worn. The minimum silica content in sand as determined by method given in **7** of IS : 2000-1962† shall be 90 percent.

3.1.2 Any sample of filter sand shall not contain more than 5 percent by volume of impurities, such as clay, loam, silt, etc, in one hour settlement after shaking in water in accordance with procedure described in Appendix A.

3.1.3 The sand shall not contain more than 5 percent of acid soluble matter as determined by solubility test described in Appendix B.

3.1.4 The loss on ignition, which is a measure of the organic matter present in sand, and determined by the procedure given in Appendix C shall not be more than 0·7 percent.

3.2 Grain Shape and Shape Variation

3.2.1 Shape of filter grains is important from the hydraulic and turbidity removal points of view. Rounded grains are preferable to angular ones.

3.2.2 Filter sand shall meet the requirements of effective size and uniformity coefficient as specified by the purchaser.

3.3 Sampling — Sampling and criteria for conformity for filter sand may be in accordance with **3.3.1** to **3.3.4**.

3.3.1 *Lot* — The quantity of sand received in a consignment from a single source shall be divided into a convenient number of lots of approximately equal size not exceeding 10 m^3.

*Methods of test for soils : Part IV Grain size analysis (*first revision*).
†Methods of chemical analysis of bauxite.

3.3.2 From each lot, 10 increments each weighing about 2 kg shall be collected. The increment shall be taken at regular intervals during loading or unloading. From a stationary lot, 2 increments shall be taken from the top and 2 each from the four sides. The increment in all cases shall be taken from a depth of at least 150 mm.

3.3.3 All the increments taken from the same lot shall be mixed thoroughly and reduced by the process of coning and quartering to yield a laboratory sample of required mass (about 2 kg).

3.3.4 *Criteria for Conformity* — The laboratory sample as obtained in **3.3.3** shall be tested for all the requirements and if it passes in respect of them the lot shall be considered as conforming to this standard.

4. GRAVEL

4.1 Quality Requirements

4.1.1 Filter gravel shall consist of hard, preferably rounded stones with an average specific gravity of not less than 2·5 and shall be free from clay, sand, loam and organic impurities of any kind.

4.1.2 The gravel shall contain not more than 2 percent by mass of thin, flat or elongated pieces (in which the largest dimension exceeds three times the smallest dimension) determined by hand picking.

4.1.3 Gravel should be free from excessive amount of limestone or shells and acid solubility determined in accordance with procedure given in Appendix B should not exceed the following limits:

a) For gravel sizes 10 mm or larger — 10 percent solubility

b) For sizes smaller than 10 mm — 5 percent solubility

4.2 Sampling — Sampling and criteria for conformity for gravel shall be in accordance with **4.2.1** to **4.2.4**.

4.2.1 *Lot* — The quantity of gravel received in a consignment from a single source shall be divided into a convenient number of lots of approximately equal size not exceeding 25 m^3.

4.2.2 From each lot 25 increments each weighing about 5 kg shall be collected. The increments shall be taken at regular intervals during loading or unloading. From a stationary lot the increment shall be taken by a suitable method so as to represent the material in various locations of the lot.

4.2.3 All the increments taken from the same lot shall be mixed thoroughly and then reduced by the process of coning and quartering to yield a laboratory sample of about 5 kg.

4.2.4 *Criteria for Conformity* — The laboratory sample as obtained in **4.2.3** shall be tested for all the requirements. If it passes in respect of all of them, the lot shall be considered as conforming to this standard.

APPENDIX A

(*Clause* 3.1.2)

TEST FOR DETERMINING IMPURITIES, SUCH AS CLAY, LOAM, SILT, ETC

A-1. PROCEDURE

A-1.1 Fill a 1 000 ml calibrated measuring cylinder with filter sand to be tested to half its volume and add water until the cylinder is three-fourths full. Shake up the mixture vigorously and allow it to settle for one hour.

A-2. REPORTING OF RESULT

A-2.1 Report the volume of impurities standing over the sand as percentage of volume of sand.

APPENDIX B

(*Clauses* 3.1.3 *and* 4.1.3)

ACID SOLUBILITY TEST

B-1. PROCEDURE

B-1.1 Rinse a minimum of 10 g of sample with distilled water to remove all dust and fine material, dry at 103°C in hot air-oven for one hour, cool and weigh. Immerse in 40 percent (*v/v*) hydrochloric acid for a period of 24 hours at room temperature. After 24 hours of immersion, wash the sample thoroughly with distilled water, dry at 103°C in hot air for one hour, cool and weigh.

B-1.2 The percentage of solubility is given by the formula:

$$\text{Solubility percentage} = \frac{\text{Loss in weight}}{\text{Original weight}} \times 100$$

APPENDIX C

(*Clause* 3.1.4)

LOSS ON IGNITION TEST

C-1. PROCEDURE

C-1.1 Rinse a minimum of 10 g of the sample with distilled water to remove dust and fine material, dry at 103°C in hot air-oven for one hour, cool and weigh. Ignite the sample at 550°C in an electric muffle furnace for one hour, cool and weigh.

C-2. CALCULATION

C-2.1 Calculate percent loss on ignition using the following formula:

$$\text{Loss on ignition} = \frac{\text{Loss in weight}}{\text{Original weight of sample}} \times 100$$

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