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IS 7208 (1992): Guidelines for flocculator devices [CED 24: Public Health Engineering.]



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भारतीय मानक

ऊर्त्रक युक्तियों की सामान्य अपेक्षाएं

(पहला पुनरीक्षण)

Indian Standard

FLOCCULATOR DEVICES GUIDELINES

(*First Revision*)

UDC 628.162.5.065

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Public Health Engineering Equipment Sectional Committee had been approved by the Civil Engineering Division Council.

After the coagulant has been applied and thoroughly diffused in the raw water by rapid mixing [see IS 7090 : 1985 Guidelines for rapid mixing devices (*first revision*)], it is necessary to provide for the floc growth in orthokinetic phase. This is normally done in tank having necessary equipment for flocculation purposes. Direct mixing by pumps is permissible only for small plants up to 20 m³/h.

In the design of flocculation units consideration should be given to the volume of flow and chemical processes involved in the treatment plant. Flocculation basins are square, rectangular or circular in shape proportioned to suit the equipment used and the area available. The units are located between the mixing basins and the sedimentation basin and may be a separate basin or a combination unit of flocculation and sedimentation.

This standard was first published in 1974. In this revision, besides making reference to the recent Indian Standard for various types of materials allowed in the standard, following major changes have been made:

- a) Design guidelines based on velocity gradient has been given; and
- b) For the safety of motor, method of cooling and type of enclosers providing protection have been given.

Indian Standard

FLOCCULATOR DEVICES GUIDELINES

(First Revision)

1 SCOPE

1.1 This standard lays down guidelines for design and construction of flocculator devices used in water treatment works.

1.2 This standard does not cover air agitation devices as such types have not been used in India.

2 REFERENCES

The Indian Standards listed in Annex A are necessary adjuncts to this standard.

3 TERMINOLOGY

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

3.1 Detention Time

It is the period which is theoretically required for a unit volume of water to flow through the basin. It can be evaluated by dividing the tank volume by the flow rate.

3.2 Velocity Gradient

For laminar flow, it is the rate of change of velocity with respect to the distance in the direction perpendicular to the velocity and is generally expressed as mps/m or sec^{-1} . For paddle flocculator the velocity gradient is given by:

$$G = \left[\frac{1}{2} \frac{C_D A_p \rho (V_p - V_w)^3}{\mu V} \right]^{\frac{1}{2}}$$

in which C_D is coefficient of drag which varies between 0.8 to 1.9; A_p is the area of paddle in m^2 ; V is volume of water in the flocculation in m^3 ; V_p is the velocity of the tip of the paddle in m/s; V_w is the velocity of water adjacent to the tip of paddle in m/s. ρ is the density of water in kg/m^3 and μ is the dynamic viscosity of water kg/m . Tip velocity of the paddle should normally be in the range of 0.2 to 0.6 m/sec.

4 DESIGN CONSIDERATION

4.1 Detention Time

A period of 10 to 30 min is recommended.

5 METHOD OF FLOCCULATION

The general method adopted in India is by mechanical flocculation¹ through the use of paddles.

6 MANUFACTURE

6.1 Mechanical Paddles

The construction of common type of mechanical paddles is given below:

- a) *Type A* — It consists of a series of paddles placed transversely across the tank width as illustrated in Fig. 1. These paddle rows are arranged to impart a barrel roll effect to the water, which causes the forming floc particles to pass through every zone in the water and to impinge on each other and with suspended matter to cause a densening of the floc into small, globular like particles which will settle rapidly. There are usually two or more additional up and down travel to the floc particles. The paddles are driven by means of a motor drive unit, either of the constant speed or multiple speed type on the tank wall or in a dry well, with chain drive to the shaft.
- b) *Type B* — It consists of a central shaft installed longitudinally in the centre of a basin parallel to the direction of flow, with paddles attached which rotate about the central shaft in a direction perpendicular to the flow, as shown in Fig. 2. These units are usually equipped with multiple speed drives and baffling is required at intervals to prevent the water from 'coring' through the centre of the basin along the shaft in the area of the minimum turbulence.
- c) *Type C* — It consists of paddles fixed to a vertical shaft operating in the centre of a square or round basin with or without peripheral baffles as illustrated in Fig. 3. Two sets of inter meshing paddles are provided, one stationary and the other moving, or both moving in opposite directions.

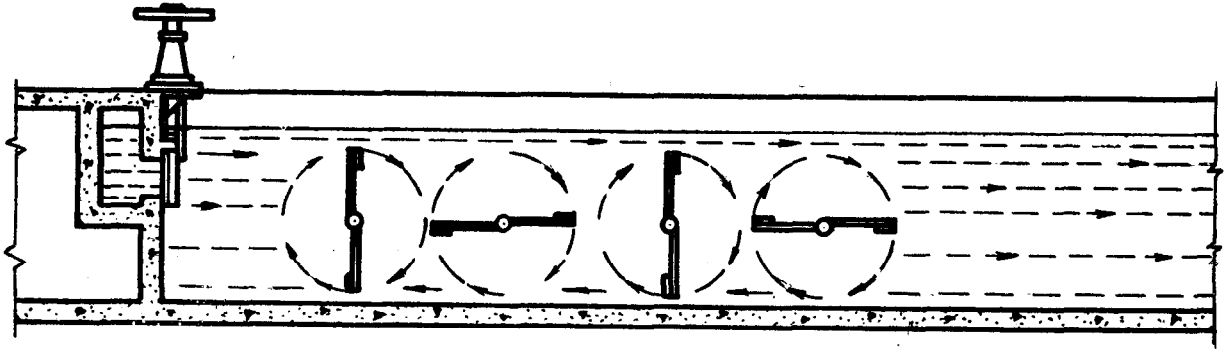


FIG. 1 FLOCCULATORS INSTALLED TRANSVERSELY ACROSS (TYPE A)

6.1.1 The depth of flocculation basins is not limited except by practical considerations. Sufficient depth should be used to reduce the number of mechanical units and to give a reasonably deep body of water for the paddles to work in.

6.1.2 The total paddle area may vary from 10 to 25 percent of the tank sectional area in the plane of the shaft.

6.1.3 The head loss in the mechanical flocculator is generally of the order of 150 mm.

6.1.4 The proper speed of the mechanical agitator depends on the type of paddle, the character of water and floc built-up. The peripheral speed should not be less than 0.2 m/s and not greater than 0.6 m/s.

6.1.5 The velocity gradient, G is generally varying from 10 to 75 sec^{-1} range of dimensionless factor, Gt , is 10^4 to 15^5 and power consumption varies between 10 to 36 w/m^3 .

6.1.6 The inlet should be designed to distribute the mixed water uniformly among different basins and uniformly over the cross-section of each basin.

6.1.7 Water leaving the flocculator units should flow into the sedimentation basin through slots or effluent ports. Freely discharging weirs have a tendency to break fragile floc. Where water carrying floc has to pass through channels or pipes before reaching sedimentation basins, the velocity in such channels or pipes should be held between 15 to 25 cm/s to prevent settling or breaking up of the floc.

6.1.8 Chamber walls shall be constructed of masonry or reinforced cement concrete.

6.1.9 Suitable materials for main component parts of mechanical paddles are given below:

- a) *Paddles* — mild steel; 6 mm thickness conforming to IS 226 : 1975.
- b) *Solid shaft* — mild steel of sufficient thickness to resist all forces coming on the shaft but not less than 50 mm diameter.
- c) *Motor* — The motor shall be totally enclosed fan-cooled type conforming to IS 325 : 1978 having method of cooling IC41 (see IS 6362 : 1971) and having enclosures providing protection IP54 or superior (see IS 4691: 1985).
- d) *Chain* — steel (see IS 226 : 1975).
- e) *Shaft couplings* — It shall be of cast iron not less than Grade FG-200 of IS 210 : 1978.
- f) *Shaft bearings* — The bearing should be suitable for work under water and under suspension conditions.
- g) *Reduction gears* — It shall be of steel (see IS 3930 : 1979) or any other suitable material.

6.2 Red-oxide (zinc chromate) shall be used as primer for painting. One coat of primer and at least 3 coats of finishing paint after erection shall be applied [see IS 1477 (Part 1) : 1971 and IS 1477 (Part 2) : 1971].

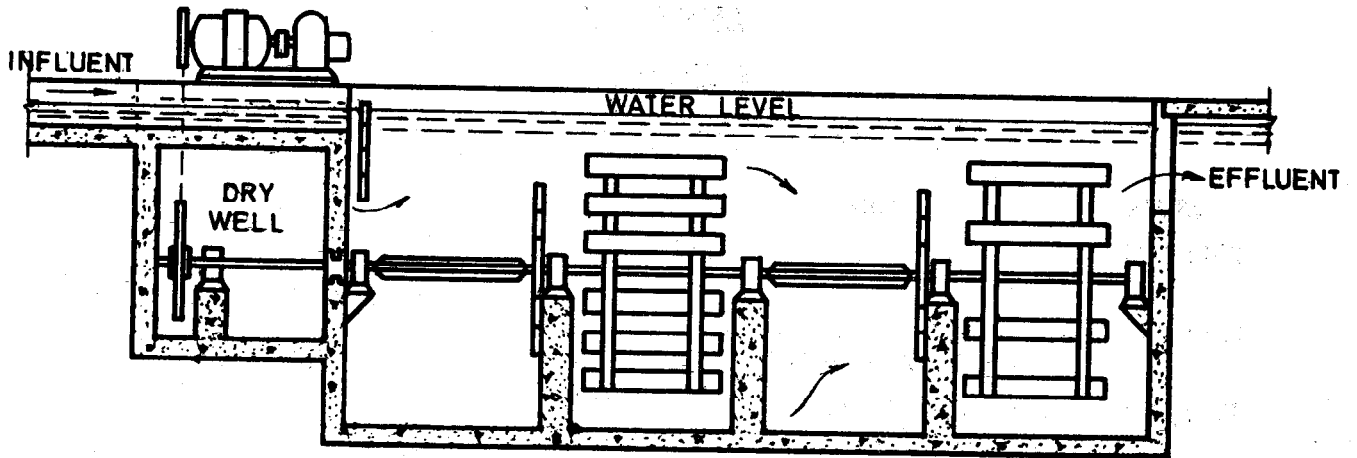


FIG. 2 FLOCCULATORS-LONGITUDINAL FLOW (TYPE B)

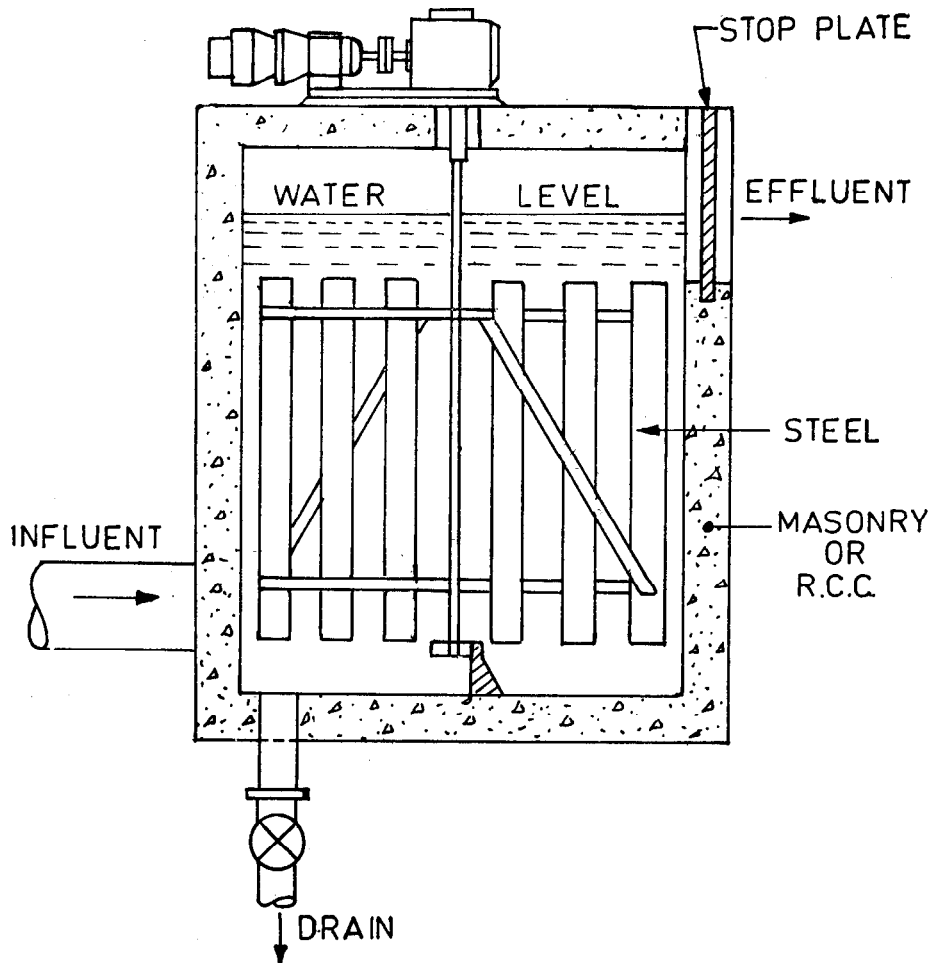


FIG. 3 VERTICAL FLOCCULATOR (TYPE C)

ANNEX A

(Clause 2)

LIST OF REFERRED INDIAN STANDARDS

<i>IS No.</i>	<i>Title</i>	<i>IS No.</i>	<i>Title</i>
210 : 1978	Grey iron castings (<i>third revision</i>)	1477 (Part 2) : 1971	Code of practice for painting of ferrous metals in buildings : Part 2 Painting (<i>first revision</i>)
226 : 1975	Structural steel (standard quality) (<i>fifth revision</i>)	3930 : 1979	Flame and induction hardening steels (<i>first revision</i>)
325 : 1978	Three-phase induction motors (<i>fourth revision</i>)	4691 : 1985	Degrees of protection provided by enclosure for rotating electrical machinery (<i>first revision</i>)
1477 (Part 1) : 1971	Code of practice for painting of ferrous metals in buildings : Part 1 Pretreatment (<i>first revision</i>)	6362 : 1971	Designation of methods of cooling of rotating electrical machines

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BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002
Telephones : 331 01 31, 331 13 75

Telegrams : Manaksanstha
(Common to all Offices)

Regional Offices :

	Telephone
Central : Manak Bhavan, 9 Bahadur Shah Zafar Marg NEW DELHI 110002	{ 331 01 31 331 13 75
Eastern : 1/14 C. I. T. Scheme VII M, V. I. P. Road, Maniktola CALCUTTA 700054	{ 37 84 99, 37 85 61, 37 86 26, 37 85 62
Northern : SCO 445-446, Sector 35-C, CHANDIGARH 160036	{ 53 38 43, 53 16 40, 53 23 84
Southern : C. I. T. Campus, IV Cross Road, MADRAS 600113	41 24 42, 41 25 19, 41 23 15, 41 29 16,
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