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The Using Modified Paddle Agitator for Increase the Performance of the Aeration Tank

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Introduction

At carrying out biological treatment of wastewater from petrochemical and oil refining industries with pneumatic aerators, one most often has to deal with wastewater with increased foaming ability. The foaming is usually eliminated by installing a vane agitator with aim to create a vortex funnel [1].

During the operation of mechanical rotating mixers, a funnel appears on the surface of the liquid, which grows with an increase in the rotation frequency of the mixer. With working of mixer the funnels depth can reach the stirrer blades [2]. Which reduces the efficiency of the mixer?

Description

The proposed design of the mixer forms a funnel that does not encircle the blades and at the same time creates surface aeration in the aeration tank (Figure 1). With further increases the intensity of mass transfer during the aeration process and, as a result, increases the productivity of the aeration tank [3].

Figure 1. Modified paddle agitator model.

The above is justified by studying the intensity of oxygen dissolution in an improved aeration tank (Figure 2), by measuring the oxygen concentration in saturated water at the outlet. At the entrance to the aeration tank, natural water deoxygenated in a vacuum was used to carry out the aeration process [4]. The intensity of mass transfer, and therefore productivity, was estimated with the relations of oxygen concentration at the outlet of the aeration tank and the residence time (Figure 3).

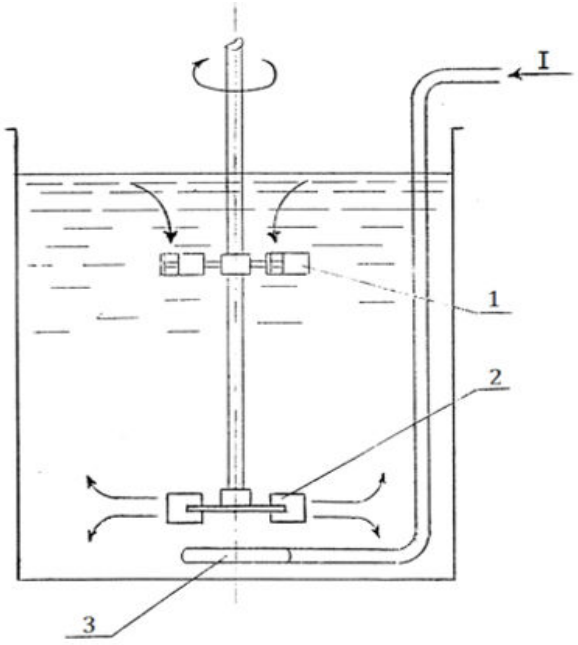

Figure 2. 1-modified paddle agitator; 2—Rushton turbine agitator; 3—ring for sparging gas; I—air feed.

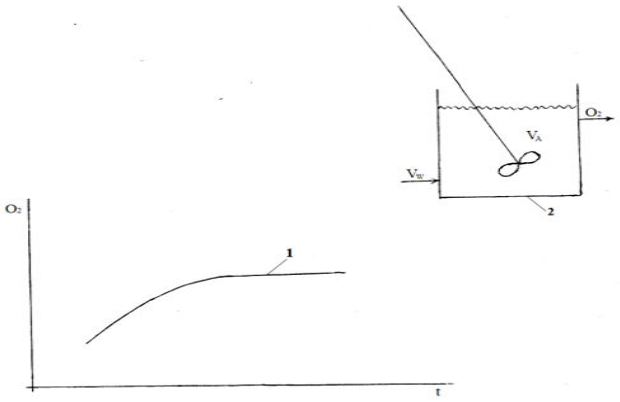

Figure 3. The relations of oxygen concentration at the outlet of the aeration tank and the residence time.

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O^2—oxygen concentration in the water aeration tank outlet (mg/L)

t—residence time (sec)

V_w—the volume of water supplied to the inlet of the aeration tank (m^3/s)

V_A—volume of the aeration tank (m^3)

1—oxygenated water.

2—principle scheme of aeration tank.

The equations for obtaining data (Figure 1)

We set multiplicity of feed. Is determined the volume of water at the inlet of the aeration tank [5].

$V_W=(V_A\ \theta)/\omega$

θ—multiplicity feed of water to aeration tank.

ω=3600 sec—hour cycle.

Next calculates the residence time.

$t=V_A/V_W$

We check the multiplicity feed.

$\theta=\omega/t$

Description of the agitator design and principle effect.

At (Figure 4) is given the improved paddle agitator that have blades are manufactured from two cylindrical semicircles displaced to each other. The passing this decision of form of the blades is directed for creating vortex funnel with minimum expenditure of energy. It's knowledge so this type of vortex makes surface stream moving in circulation stream into lower layers of the liquid. With this the rich by oxygen water arrives to most volume of aeration tank. This way surface aeration is appeared in the aeration tank [6].

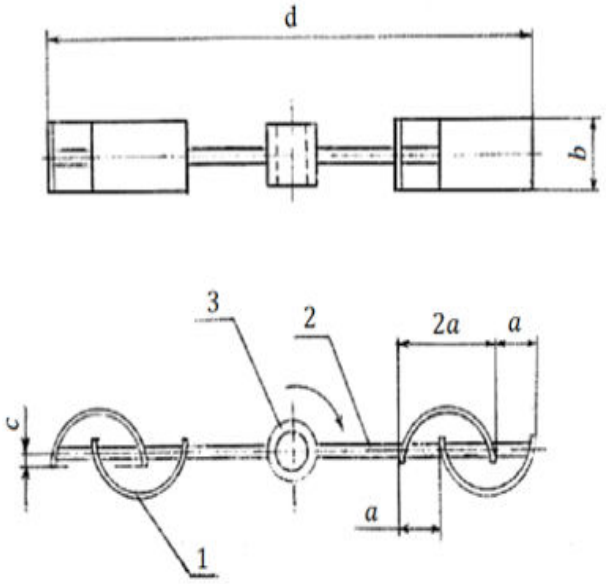

Figure 4. Drawing of the modified paddle agitator.

Notations on the drawing (Figure 4).

1—cylindrical semicircle; 2—crossmember; 3—hub

Nomenclature.

d—agitator diametr;

a=1/10 d—semicircle radius;

b=1/8 d—blade width;

c=1/20 a

Practace: With intense tangential flow of liquid in the area of the shaft and agitator, a cylindrical vortex—Rankine vortex [2] is formed, which can be represented as a paraboloid of rotation. The depth and shape of the funnel is most influenced by the diameter of the agitator and the frequency of its rotation. To calculate the depth of the funnel is used equation (1) with application the Froud criterion:

$h_F=(\pi n d_M)^2/2\ g$ (1)

for: $(0.05 \le Fr \le 0.45)\ Fr=(n^2 d_M)/g$

π=3.14

h_F—funnel depth (m)

n—rotation number of agitator (1/sec)

d_M—agitator diameter (m)

g=9.81(m/sec)^2)—acceleration of gravity

Fr—Froud criterion

The equation (1) is recommended as a basis of constructive calculations of a modified paddle agitator.

Conclusion

The vortex funnel has principle of intensification the mass transfer accordingly creating the funnel through mechanical devices helps to increase the productivity of the aeration tank.

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