

EXPERIMENTAL RESEARCHES CONCERNING THE CAVITATION IN CASE OF MIXTURES BY TYPE LIQUID-LIQUID (L-L)

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Abstract: In this paper it was realized an experimental study about cavitation appearance conditions to obtain a mixture by type liquid-liquid (L-L). The experiences was done, in function of: the nature of the phases into mixing operation (water-water), the geometrical shape and the geometrical dimensions of the mixing device and the mixing vessel, the highness of the mixing device into the mixture's mass.

Keywords: cavitation, mixture by type liquid-liquid (L-L) mixing device

1. INTRODUCTION

To realize the mixture by type liquid-liquid (L-L), the mechanic mixing device putted centrally (the axis of the mixing tank is co-axial with the axis of the mixing device), generate the dislocation of the whole mass of the mixture from mixing tank. Initially, around the mixing device, appear a moderate depression of the mixture, but increasing the mixing speed, the cavitation became bigger and it's expanding until the arm of the mixing device. After a time, the cavitation presents a constant depress in shape of funnel. So, this is called cavitation.

2. THE EXPERIMENTAL STAND

The experimental determinations was realized on the laoratory stand presented in the figure no. 1.1. The funnel process was analised using a mixing device by blade type (figure no. 1.2.).



Fig. 1.1. The experimental stand

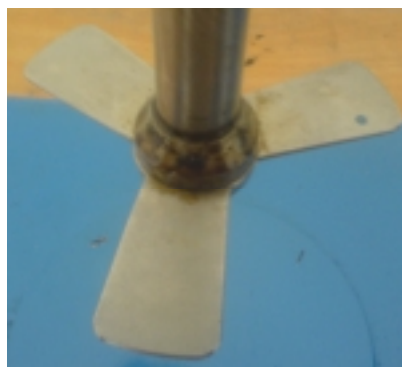


Fig. 1.2. The mixing device

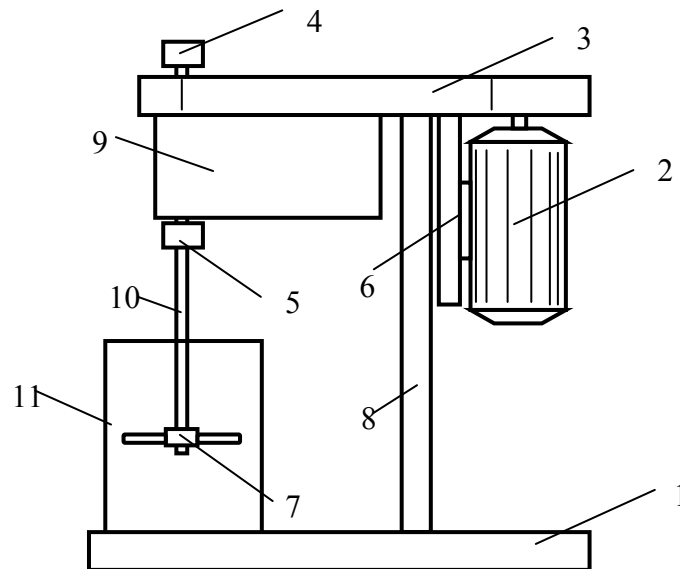


Fig. 1.3. The scheme of the experimental study:

1 – sustaining device; 2 – the electric engine; 3 – beld transmission; 4 – guidance element; 5 – arrangement device for shaft's depress in the mixing tank; 6 – sustaining element of the electric engine; 7 – working element by blade type; 8 – sustaining element; 9 – the bearings; 10 - shaft; 11 – cylindrical tank.

The movement of the mixing device is taken from the electric engine through a trapezoidal belt. The experimental stand has a cylindrical tank with dimensions: $D_i = 145$ mm and $H = 240$ mm.

For studying the cavitation into a liquid (water) the stand has the possibility to change the position on the vertical axis of the mixing device.

To do this, it is utilized a consolidation system by screw chuck type.

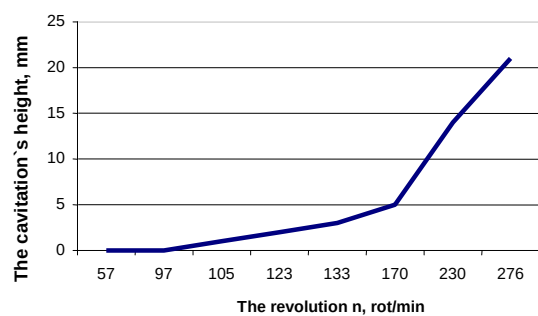
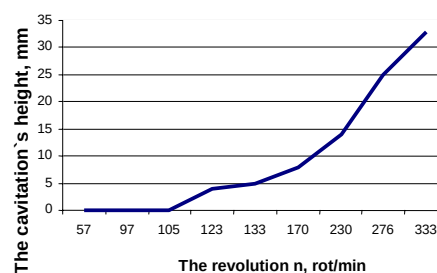
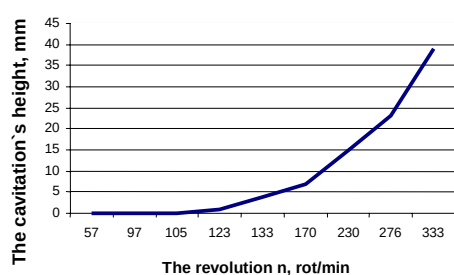
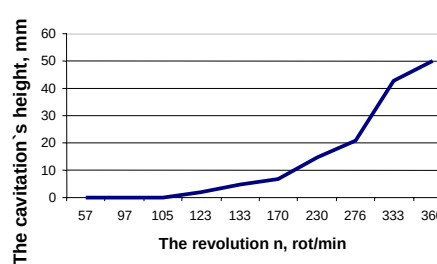
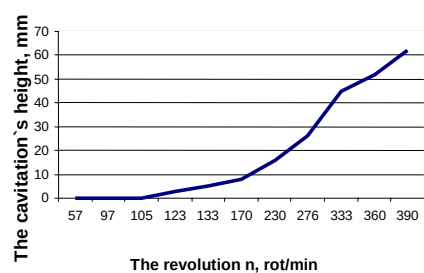
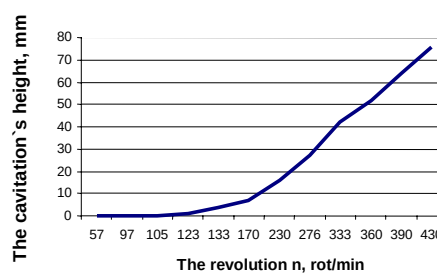
3. THE RESEARCH METHOD

For the cavitation study has been followed:

- the mixture type: homogenous mixture by type liquid-liquid (water-water);
- the geometrical dimensions of the mixing tank:
 - $D_i = 145$ mm;
 - $H = 240$ mm;
- the dimensions of the mixing device:
 - the blades: 3;
 - the width of blade: 20 mm;
 - the diameter of the circle described by type the blades: 90 mm;
 - the shafts diameter: 15 mm;
 - the shafts length: 480 mm;
- the revolution of the mixing device: $n = 57, 97, 105, 123, 133, 170, 230, 276, 333, 360, 390, 430, 460, 505, 525, 540$ rot/min;
- the height of the mixture: $h = 140$ mm;
- the depth of the mixing device into the mixture: $h_d = 10; h_d = 20; h_d = 30; \dots h_d = 110$ mm;

4. THE EXPERIMENTAL RESULTS

In the figures 1.4 ÷ 1.14 are presented the obtained experimental results.

Fig.1.4. The height of the cavitation for $h_d = 10$ mmFig. 1.5. The height of the cavitation for $h_d = 20$ mmFig. 1.6. The height of the cavitation for $h_d = 30$ mmFig. 1.7. The height of the cavitation for $h_d = 40$ mmFig. 1.8. The height of the cavitation for $h_d = 50$ mmFig. 1.9. The height of the cavitation for $h_d = 60$ mm

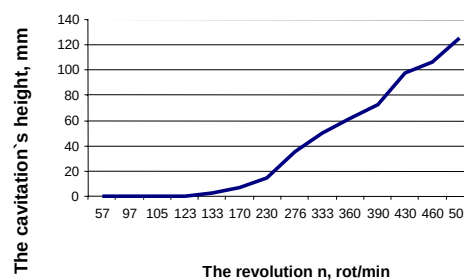
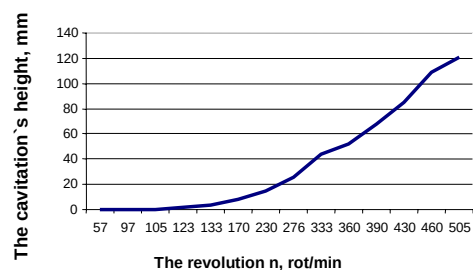


Fig. 1.10 The height of the cavitation for $h_d = 70$ mm Fig. 1.11 The height of the cavitation for $h_d = 80$ mm

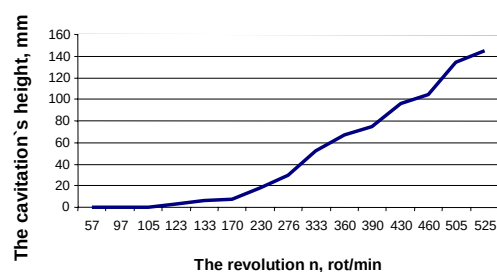


Fig. 1.12 The height of the cavitation for $h_d = 90$ mm Fig. 1.13. The height of the cavitation for $h_d = 100$ mm

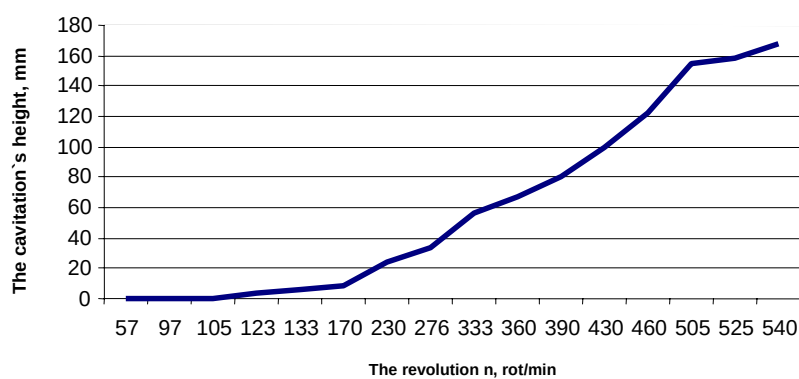


Fig. 1.14. The height of the cavitation for $h_d = 110$ mm

By combination the graphics presented, can be visualize the cavitation's variation in function of the depth and revolution of the mixing device (fig. 1.15).

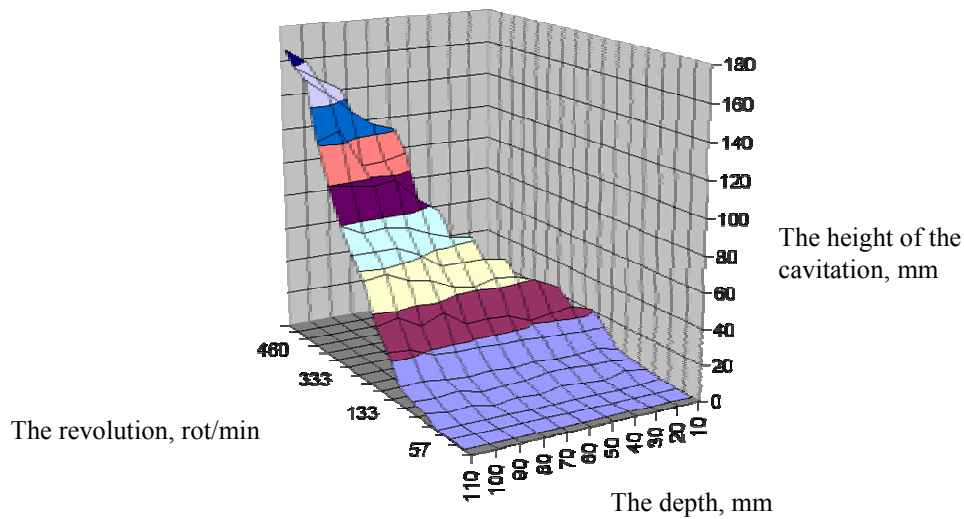


Fig. 1.15. The variation in function of the shaft's revolution

For this study it was realized a mathematic model (1) helped by *Table Curve 3D Program* obtaining 0,97 correction index (fig. 1.16).

$$\begin{aligned}
 z &= a + bx \ln x + cx^{1,5} + dx^{0,5} \ln x + \frac{ex}{\ln x} + fy + gy^{2,5} r^2 = 0,9926276 \text{ DF Adj} \cdot r^2 = \\
 &= 0,97542532 \text{ FitStdErr} = 7,3410894 \text{ Fstat} = 89,760661 \\
 a &= 206606,71; b = 1806,2296; c = 66,804928; d = 46013,401; e = 142517,26 \\
 f &= 0,72447639; g = 0,00040633403
 \end{aligned} \tag{1}$$

where:

x – the mixing device's revolution;
y – the height of the mixing device;
z – the height of the cavitation.

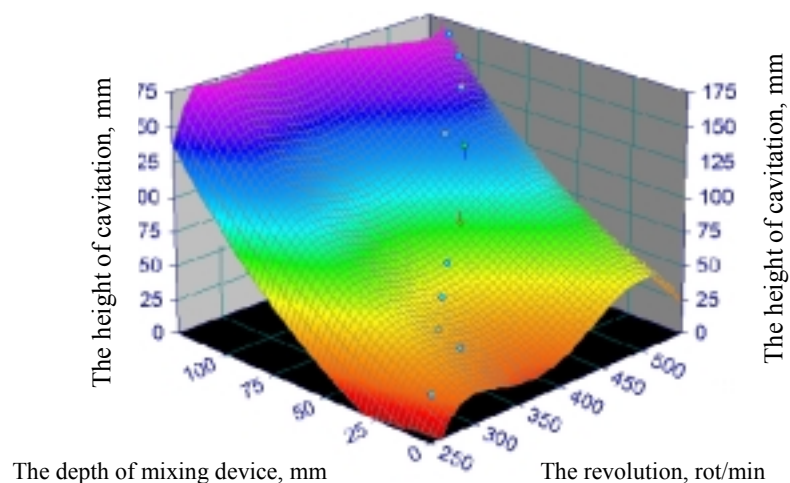


Fig. 1.16. Mathematic model 3D representation

5. CONCLUSIONS

The experimental determinations:

If the cavitation appear, the mixing operation became inefficient because only a part of the mixture located on top of the cavitation (at bottom of mixing tank) is moving. From this cause, results a mixture with low homogenization degree;

Analyzing the graphics from figures 1.4 – 1.14, it was observed that the cavitations depth grows with the increasing of the mixing device's revolution;

The experimental researches show that the cavitation appearance is generated by gravitational force which increases at high speeds;

In figure no. 1.15 it was realized the mathematic model which described the appearance of cavitation in function of the mixing device into the mixture;

The mixing operation with cavitation has as inconvenient the under finite flow, that study of the flow spectrums was realized by adding to mixture a coloring matter;

The flow spectrums represent the resultant of two movements: the local movement of the mixture delivered from mixing device and general movement of the mixture from mixing tank. Those two movements are classified between the un self especially by their speeds;

The mixing operation with cavitation shows the disadvantage of power consumption determination, because the power needed for mixing operation is in function of flowing spectrum which is born in mixing tank.

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