THEORETICAL STUDIES CONCERNING THE REALIZATION OF THE CAVITATION AND COMSUPTION POWER IN MIXING OPERATIONS

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Abstract: Author`s propose the saddle analysed the theoretical study of realization processes of intermingle with the formation of cavitation and fixing mathematically relations for determination of consumed power.

Keywords: cavitation, food products, non – Newtonian, consumption power, viscosity

1. INTRODUCTION

The mixing presupposes the average motion of thing, and prerequisite for method his setting actuating in the si maintains then in acesta state is infleuntata proprietorial material component. The what averages must mixed fluid by-path, is constituite from solid particle, is am composed from both guys of material, fluid and solid particle.

In food industry, operation of mixing gambles an important role in the of a frame technological process, in proportion of:

- as free operation (stagnant rail of precinct 30% from situation) having as aim the homogenization ultimate systems, produce the emulsions or dispersions etc;

- as auxiliary operation (chaperone of precinct 70% from situation) when he has as aim the change physical of a state phase entered in blend(flocculation, dissolution) , the acceleration reaction chemical, the intensification absorption (ex. the discolouration vegetable oils, the removal smells, etc.), the of a solid washing and the removal impurity (ex. the washing beets saccharine in industry starch, the washing tubers of potatoes in industry starch, the washing cereals), the intensification transfers of heat, etc.

In food industry the determination consumptions of energy for which blenders achieve the non – Newtonian blends (he grazes, emulsion, were), treaty much more than the relations for the computation can necessary obtaining non – Newtonian blends, be so for unsolved complete, because of great variety non – Newtonian blends

2. MIXING EVOLUTION

Mixing process is achieved in two phases: in first phase is achieved a local mixing around devices of which mixing achieves the mixing, forming the little zone of intermeddling which come into existence the current (figure no.1), with different what speed adjourn to the of a movement volume of material; in two phase volume of material submissive mixing, finded out the in around devices of mixing dislodging of enviroment volume of material (figure no2).

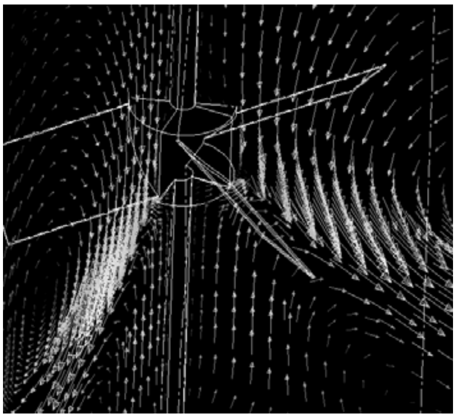

Fig. 1. Air current

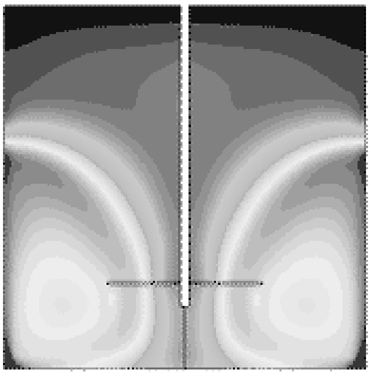

Fig. 2. Mixing evolution

2. FIXING MATHEMATICALLY RELATIONS FOR DETERMINATION OF CONSUMED POWER

The most important element in mixing device calculation is the determination of power because the power consumed gives a direct influence to the economic balance of the mixer.

To calculate the consumed power for non - Newtonian final systems, it used the apparent viscosity, because from rheological point of view, are characterized by consistency (the viscosity variate with velocity gradient or/and time of deforming tension action.

The particular viscosity is not direct measurable, one of methods for determination is: suppose that the movement of pseudo – plastic non –newtonian or Bingham plastic can be characterized by velocity avarage gradient proportionaly with stirres speed, can be determinate this velocity gradient if we know *n* and a constant k_a, bared on tangential tensoin relation (1):

$$\left(\frac{dv}{dr}\right)_m = n \cdot k_a \tag{1}$$

where: $\left(\frac{dv}{dr}\right)_m$ represent the average reopanta for the apparent viscosity determination, s^{-1};

n the revolution of mixing device, rot/s;

k_a the constant depending by mixer type.
It's necessary like dependention between velocity gradient and tangetial tension to be determinate into a viscosimeter and from non on is posible to determinate the apparent is viscousity η_a for the velocity gradient that we have.

For the apreciation of non - newtonian tipe of final sistem, it`s determinated the flowing index, notated a and calculated be ecuation (2):

$$\vartheta = K\left(\frac{dv}{dr}\right)^a \tag{2}$$

where:
ϑ represent the tanfential tension, N/m^2;
k – consistence coeficient, Ns/m^2;

By expanding of Re expresion and introducing of apparent viscousity, Metzner and Otto obtain the ecuation for determination of consumed power, in this shape (3):

$$N = 71\eta_a n^2 d^3 \qquad [\text{kgf m/s}] \tag{3}$$

where:
η_a represent the apparent viscousity, kgf s/m^2;
d the mixer diameter, mm;
n the mixer revolution, rot/s.

For expansible mixtures, appear a dependention between tangetial tensoin and report of the mixer diameter and the mixing vessel, this corelation, it`s described by relation (4):

$$\left(\frac{dv}{dr}\right)_m = 38n\left(\frac{d}{D}\right)^{0,5} \tag{4}$$

where:
dv/dr represented the reopanta;
m incline, mm;
n the revolution of mixing device, rot/s;
d the diameter described by mixing device, mm;
D the diameter of the vessel, mm.

The most important problem for determination consumed power, it`s the calculation of non – Newtonian final sistem viscousity by mixing device revolution.

The viscousity mixing is determinate by relation (5):

$$\eta_a = \frac{k}{(8n)^{1-a}}\left(\frac{3a+1}{4a}\right)^a \tag{5}$$

where: η_a represent the apparent viscousity, kgf s/m^2;
n the mixer revolution, rot/s,

k the consistence value; Pa s^n;
a the flowing index

3. CONCLUSIONS

The calculus relations of consumed power from mixing process of non – Newtonian sistems and the calculus relations for viscousity determination represent correlations for obtain consumed power in case of turbine and anchor mixers; thie corelations can be used specially for pseudo – plastic materials, wtih Bingham plasticity and with dilatation.

Viscosity is one measure of flowing resistence provocated by internal friction. For laminar flowing, the consumed power is proportionaly direct with viscousity.

If the geometricaly variables and the revolution are remaining constant an increasing of one fhousand times of viscousity doens`t modify the consumed power.

The process modeling results on local mixture whit great speed follow by general mixture whit depresed speed.

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