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Influence of forced material in roller compactor parameters II.

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In the chemical, pharmaceutical and food industry, many problems in transport, storage and handling of pulverised products are caused by formation of dust. Using roll-type presses to compact such materials, dust-free products can be realised. In the first part of this paper we described the model of compaction process in the roller press. In this part we show some of our results.

Summary

If the equipment is designed, we can adjust Johanson theory. The role of contribution is to show the interdependence between the parameters which describe the compacting process. Our equipment has the technological conditions to withstand measurements in higher pressures. It is very interesting for us the effects of the forced material into roll gab, roll diameter, roll force and so on. In the figure 4 there is possible to understand the change of the roll force according the roll diameter. In figure 5 is shown the change of the roll diameter according the nip angle.

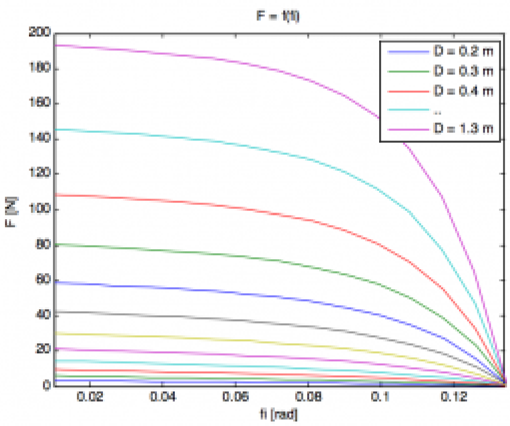

Figure 4 The graphical behaviour roll force into roll diametere

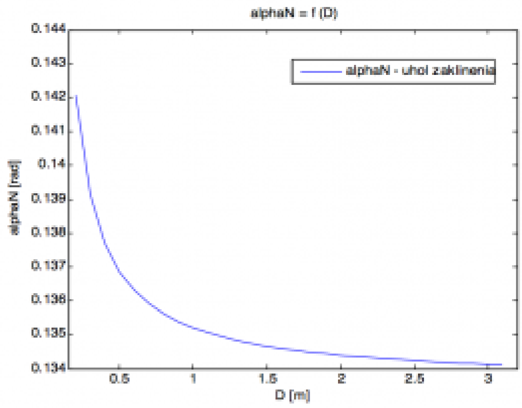

Figure 5 The graphical behaviour roll diameter into nip angle

Influence of forced material /filling/ into gab size, roll sizes and coefficient of compressibility is shown in the figures 6, 7, 8.

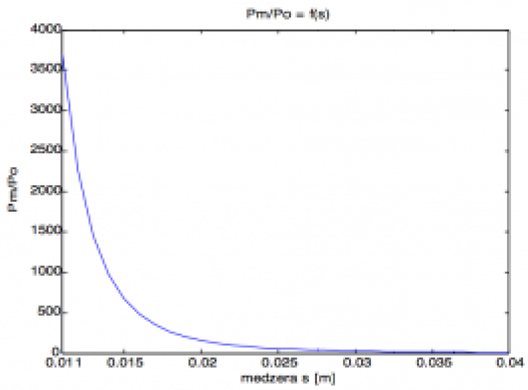

Figure 6 The Graphical behaviour p_m/p_0 into gab size

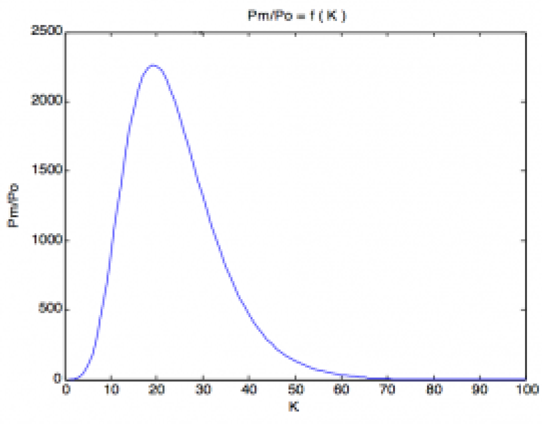

Figure 7 The Graphical behaviour p_m/p_0 into coefficient of compressibility

To calculate influence of forced material according to nip angle is necessary to change the ratio p_m/p_0.

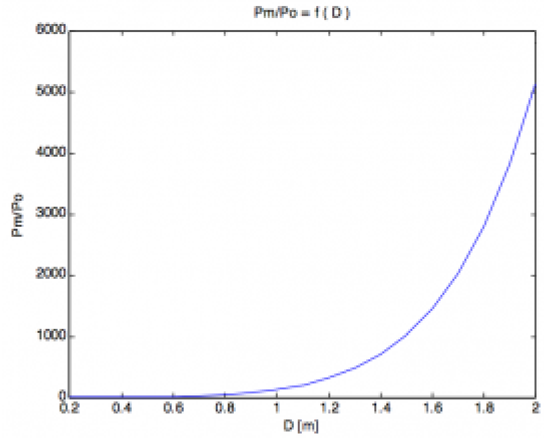

Figure 8 The Graphical behaviour p_m/p_0 from roll (D)

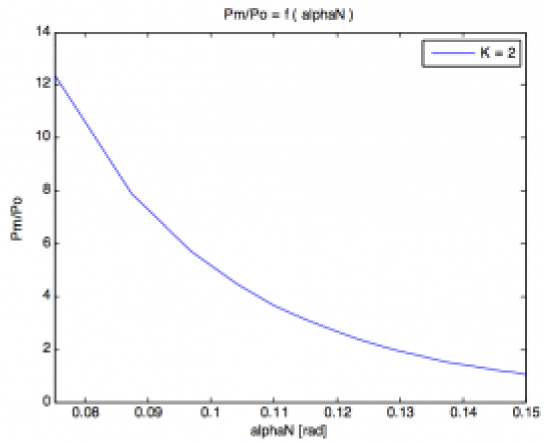

Figure 9 The Graphical behaviour p_m/p_0 from nip angle α_N

By the simplification of the equation 11 after is possible to get the equation 15

$$\frac{p_m}{p_0}\frac{1+\sin\delta}{1-\sin\delta} = R_1(\alpha_N)\frac{\sigma_\theta}{\sigma_\alpha}(\alpha_N, K) = const. \tag{15}$$

$$\frac{p_m}{p_0} = value\ X\ angle(\theta) \tag{16}$$

In the equation 15 the left member is constant so the right member is a function according αN.. The solution of that equation is too difficult that is why we suppose the ratio pm/p0 has lineal relation with the angle θ. By the simplification of the equation number 15 we will get the equation number 17 and in the figure 9 is shown the graphical solution of this equation .

$$\frac{d}{d\theta}\left[\ln\left(\frac{const.}{\frac{\sigma_\theta}{\sigma_\alpha}(\alpha_N, K)}\right)\theta\right] = \frac{d\frac{1}{R_1(\alpha_N)}}{d\theta} = \ln\frac{d\sigma_\theta}{d\theta} \tag{17}$$

Other possibilities in order to focus this problem is creating simulation programs which will be able to generate the results by auto run applications (*.exe).The results, graphs and more were obtained by using the computational program Matlab [7], but is necessary emphasize that program is running by license that is why is better to use a free software (GNU license). In this case we were using the code C in order to create our algorithms which are object – oriented . programming. For example to calculate the integral of a function in Matlab we can use the command QUAD(FUN,A,B), but in the programming language C is necessary to create this function.

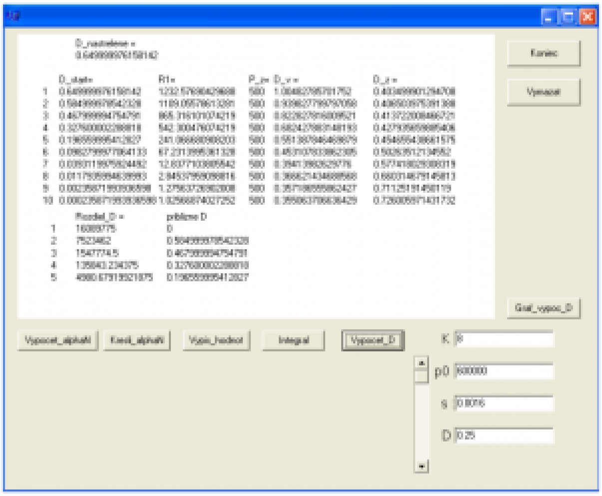

Figure 10 Calculation of the roll diameter using C++

Conclusions

The presented work deals the theoretical design of the roll compactor using the mathematical model proposed by Johanson which express the relation between the material properties, the compactor dimensions and the operation conditions. It was interesting for us to analyze the effects of the forced material into roll gab, roll diameter, roll force and so on. The obtained results using Matlab after we recalculated using C++ due to the advantages which have been descript before.

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7. Matlab Online Manual version 6.1.0.450 Release 12.1

Index symbol

A	substitution relation	(1)
B	width roll	(m)
D	roll diameter	(m)
d	average gravity canal on the surface roll	(m)
F	spacing force	(N)
K	compressibility constant for granular solid	(1)
M	torque	(N•m)
P_m	max. horizontal pressure	(Pa)
P_0	input pressure	(Pa)
s	roll gap	(m)
P_θ	pressure on axis *x*	(Pa)
α_N	nip angle	(rad)
β	help angle	(rad)
θ	angular position at the surface of a roll	(rad)
σ	normal stress	(Pa)
σ_m	max. general stress between of the rolls	(Pa)
σ_θ	medium general stress by θ	(Pa)
δ	effective angle internal friction	(rad)
φ_w	effective angle external friction	(rad)
λ	between a tangent of the surface and the tangent of a main stress	(rad)
ρ	material density	(kg.m^{-3})
ρ_s	shoot density	(kg.m^{-3})
ρ_A	compacting slip density	(kg.m^{-3})

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