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I.K. MLADETSKIY, Dr. T. Sc.
(Ukraine, Dnepropetrovsk, National Mining University),
V.S. BILETSKIY, Dr. T. Sc.
(Ukraine, Donetsk, National Technical University)

DEFINITION OF BOUNDARY VALUES OF PARTICLE FINENESS FOR MACHINE CLASSE ALLOCATION

The mathematical solution of the well-defined boundary of large, small and fine fractions of particles in the processing of bulk minerals.

At mineral raw material processing, in particular, at mineral enrichment there are a number of cases when on a curve describing loose material properties it is necessary to allocate precisely areas of large, thin and fine classes. An example can be dependences of an external loose material specific surface on grain diameter $S_n\,(d_э)$, received by V. Tovarov's method [1, 2] (fig. 1). For different materials they look like a hyperbole.

There is another example. Division of mineral particles in the water medium depends on the size d of these particles. And for all that dependence is both power and hyperbolic because the equation of their movement in a first approximation looks like

$$g\frac{\delta_T-\delta_B}{\delta_T}=\frac{18\mu U_T}{\delta_T d^2},$$

where δ_T,δ_B – density of particles and water, accordingly; μ – factor of water dynamic viscosity; U_T – speed of particle moving in the water medium.

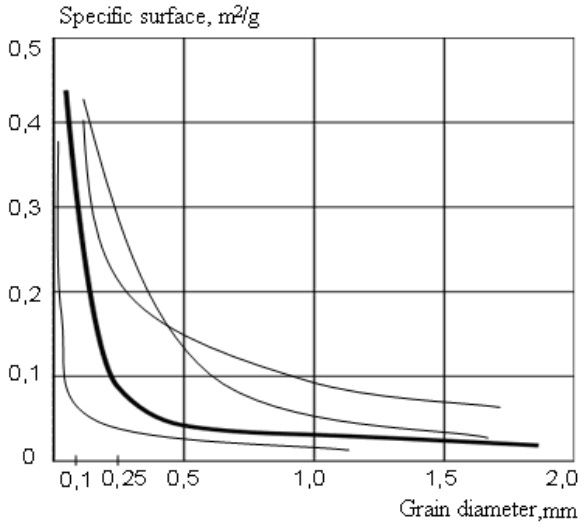

Fig. 1. Dependences of loose material external specific surface on grain diameter $S_n\,(d_э)$

If to track division parameters, for example some size β from the particle size then this dependence sensitivity $\beta = f(d)$ is hyperbolic (fig. 2). On this dependence it is possible to allocate three ranges qualitatively:

– Weak dependence, for large particles;

– Transitive area, for rather fine particles;

– Strong dependence, for thin particles.

To specify precise border between ranges (fig. 1) is not obviously possible, since the curve has no characteristic points: extreme, precise change points. At the same time, such differentiation is necessary because it allows executing preliminary characteristic classes division so that the next separation would be conducted more successfully and quality indicators would be better in a whole.

Thus, in both shown examples there is *a problem* to allocate precisely border value of the mentioned three classes – large, fine and thin particles. With this *purpose* we make some transformations of a hyperbole.

It is known, that the hyperbole has asymptotic line, to which its branches tend at argument increase. Hence, the curvature radius ρ tends to infinity ∞. Therefore, if to design a curve $\rho = f_1(d)$ there will be also a hyperbole, but having a characteristic point – a minimum – in a point corresponding to the maximal curvature (fig. 3).

The curve $\rho = f_1(d)$ also has asymptotic line and consequently a derivative for $d \to 0$ tends to constant value (and it is negative), and for $d \to \infty$ it also tends to constant value (and is positive). In a minimum point it (derivative), naturally, is equal 0 (fig. 4). Then examining the second derivative from function $\rho = f_1(d)$ we receive a curve with two change points (fig. 5), which abscises will correspond to fineness class division borders on machine ones, according to constant laws of their division.

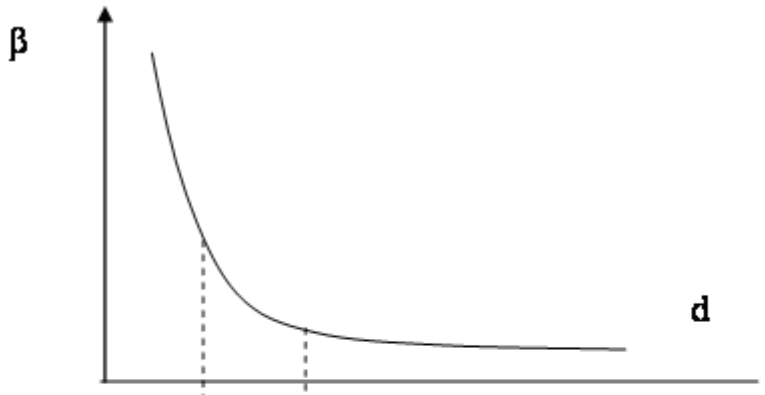

Fig. 2

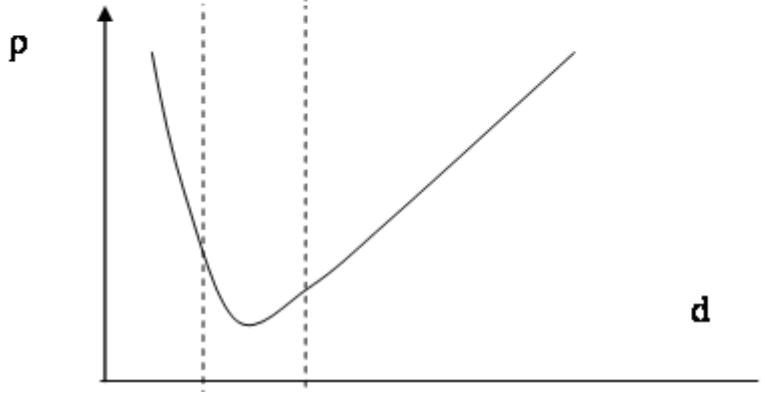

Fig. 3

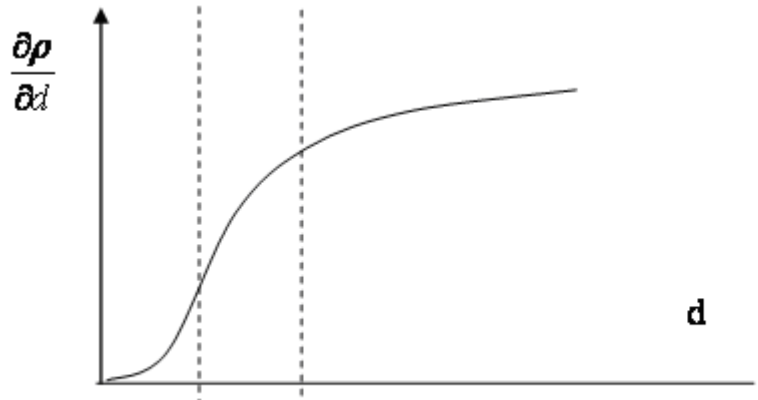

Fig.4

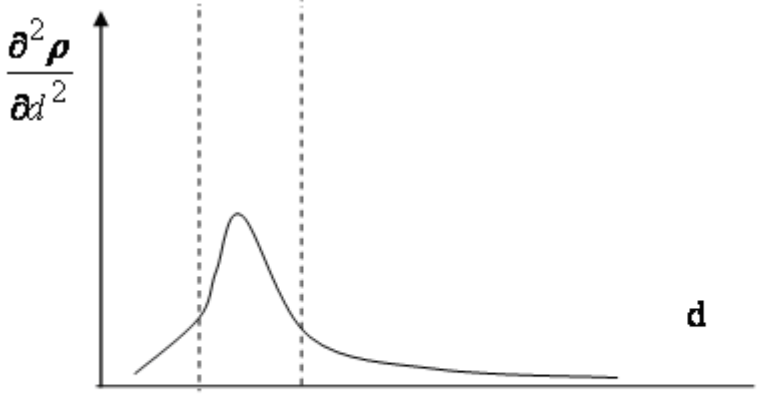

Fig.5

Conclusions

Thus to allocate large, fine and thin machine classes it is necessary:
– To design a curve $\rho = f_1(d)$;

– To take its second derivative $\frac{\partial^2 f_1}{\partial d^2}$;

– To investigate on its change points, which abscises determine required area borders of large, fine and thin machine classes.

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