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The deposits time evolution in the heat interchangers

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Abstract: Deposit, fit most general, he represents the of a material solid accumulation on a surface. The transfer to wall of these particles is can done through the many maul mechanisms, deposit through Brownian diffusion is demonstrated, at large, for particles with inferior sizes 0, 01. in work is presented an analysis of the an evolution temporally the thermic deposited two agents of thing take as example: Of the oil of transformer and the oil of engine.

1 The mechanism formation of the deposits

At option fluid which he shall flow through pipes is shall consider some property and physical sizes ale thermic agents: The degree of smutch, the corrosion, the pressure, the temperature, the virulence, flow, viscosity.

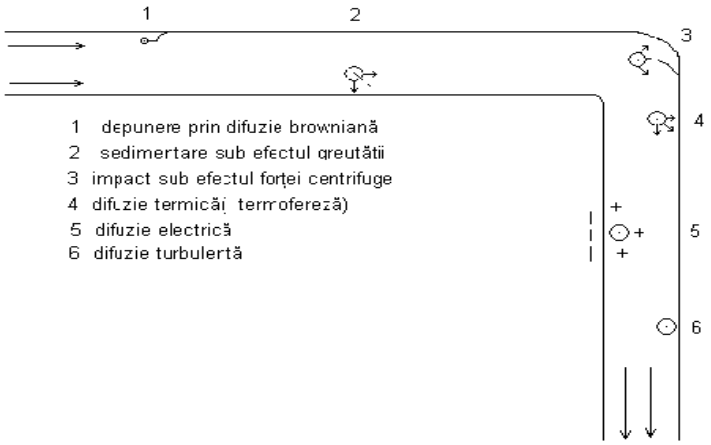

Fig. 1. *The mechanism of the deposit of the aerosols in pipelines*

Deposit through Brownian diffusion is demonstrated, at large, for particles with inferior sizes 0, 01.

Thermic diffusion he appears in the case be of a gradient of temperature in fluid, the molecular shock be else intense on the warm part than on one the particle. Appears thus displace it a particle toward the region in which fluid he is else cold. Thus, to a blast-heating apparatus particles from the burnt ges are shall displace due to thermic diffusion to the spare surface of heat the cold maul, favoring the deposits on this.

The electric forces can have a certain importance for particles with sizes the little maul of 0, 1.

In the case of the deposit through turbulence diffusion, the speed of deposit the particles is depending on for relaxation (the necessary of a time particles with initial null speed to touch 63 from his speed of free fall in average respective presumed non-moving). they emphasized three regimes of a prime deposit regime checked up of diffusion, with a steady speed of a second deposit regime of ascending speed checked up of the interaction between the inertia of the particles and the turbulences and of third regimes

whereat the inertia becomes the preponderance and whereat the speed of the deposits becomes easy descending.

The which particles arrive at the wall is fixed on this by reason of the molecular attraction forces (the forces Van de Walls), of electrostatic forces and capillaries.

The trained possibly the particles deposited on wall is in progress when the forces of which detrusion reacts on their exceed the adhesion forces and possible, the one of weight.

2. Choose the which fluid shall flow through pipes

At option fluid which he shall flow through pipes is shall considered some property and physical sizes ale thermic agents.

The degree of smutch. Fluid the dirty still more hard to maul clean is shall entered through internal pipes hereupon is can easy and efficient cleaned the mechanic. The space among pipes and cloak is hard to clean the mechanic, use of habit, if he is necessary, the dry-cleaning.

The corrosion. The fluid corrosion shall circulate as a rule through internal pipes, where through except this to need to I executed from anticorrosive materials. In the case in which for the anticorrosive protection is necessary the urbanization, this don't is can of habit achieve to internal pipes and in this cases the agent corrosive you circulate in cloak.

The pressure. The fluid with elder pressure is adequate to circulate through pipes, carry having the little diameter resists to erect pressures were necessary big thickness of wall. In the case in which fluid with erect pressure burn circulate through cloak, this thickness, therefore and her cost burn breeds considerable.

The temperature. Likewise, the hot fluid is adequate to circulate through pipes reduced the thermic stress from material decreased the thickness of the insulation of the cloak.

Toxicity. The toxic inflammable fluids, explosively or loves are shall enter fractionally most protected of habit inside out pipes, take measures of seal-off.

Flow. The fluid with minim flow is adequate to is entered in cloak, in order to obtained a less number of pass through the pipes and because to the flow across pipes the disorderly regime appears to values the little maul ale criterion Reynolds($Re_{limit}= 10^3$).

Viscosity. Fluid the viscid maul is shall entered in cloak where through in this zone is can obtained the disorderly regime of flow to values the little maul ale criterion Reynolds.

Miss of pressure. If for fluid a loss of pressure am strict limited, this shall be entered in pipes, waves the calculus of the loss is rather and can make provision for the limitation of the loss of pressure, in chief through the decrease of the speeds

3. The evolution deposited

The evolution deposited is can unfurl after one from the curves from the figure 2.

Was a law characterized of the equation:

$$R_d = k \cdot \tau \tag{1}$$

Where: K is mark evolution of inflate resistance deposits.

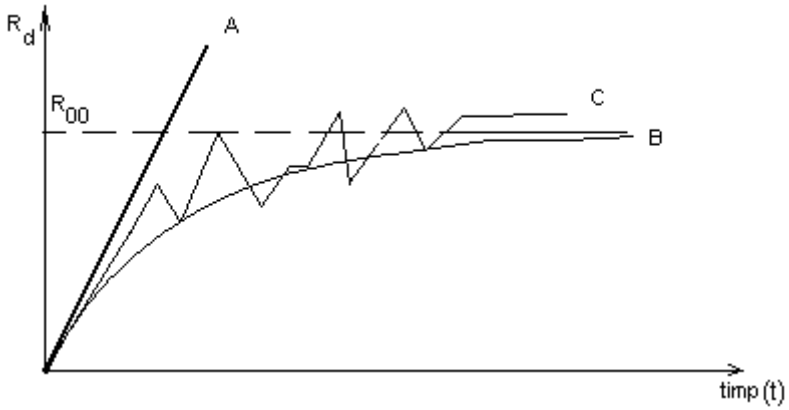

Fig. 2 *The variation temporally the resistance of the deposits*

This guys of growth characterizes the hard deposits and adhesive, the speed deposited is constant from exists trained, or the difference between Φ_D and Φ_R is constant.

A series of vaporizers can have a such feature of deposited chiefly equal-phase initial.

The evolution B is of exponential guy:

$$R_d = R_\infty \cdot \left(1 - e^{-\beta \cdot \tau}\right) \tag{2}$$

Where: R_∞ is the asymptotic value of the resistor of the deposits, in $m^2 K / W$;

β - which depends of the system properties;

In this case the speed of deposit Φ_D is constant, and Φ_R is proportional to the thickness of the deposits. The asymptotic evolution characterizes in generally deposits "large", fragile, which detached relatively easy below the action of the fluid speed.

We chose as agents of work thing the transformer oil and engine oil.

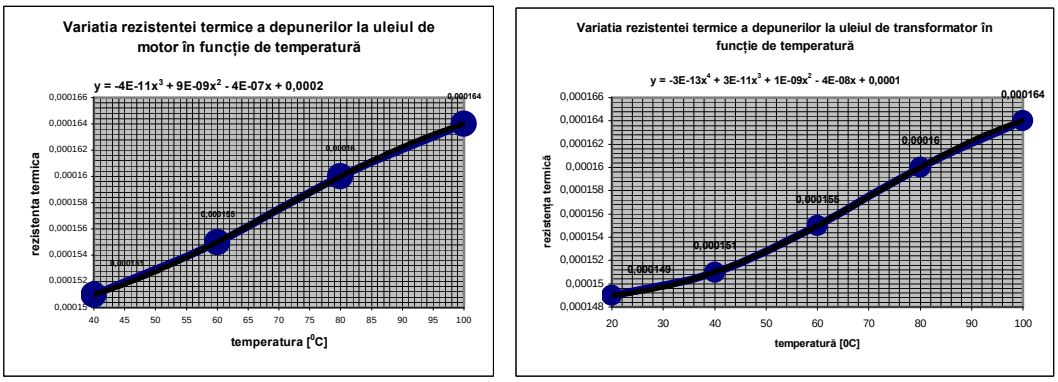

Fig. 3 *The variation of the resistance deposited depending on temperature.*

I chose as agent of thing the oil of engine and the oil of transformer, for which I considered next features.

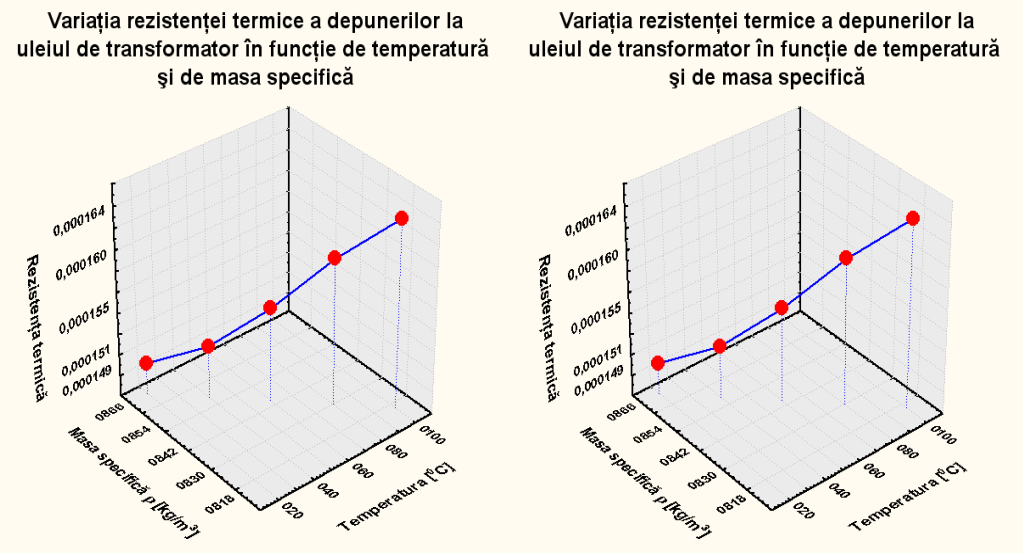

Fig. 4 *The variation of thermic deposited to the oil of transformer and to the oil of engine depending on temperature and of specific table.*

The calculus of thermic deposited calculatingly with the formula:

$$R_d = \frac{m_d}{\rho_d \cdot \lambda_d}, \tag{3}$$

Where: m_d - is massage the deposits on the above-ground unit, in kg/m^2;;

ρ_d, λ_d -the density, respectively the thermic conductivity deposited in kg/m^3, respectively $W/(m \cdot k)$.

Result property of the oil of transformer and the oil of engine to different temperatures are presented in the table 1:

Table 1

Nr.crt.	Temperature $[^0C]$	Specific mass $\rho[kg/m^3]$	Thermic conductivity $\lambda[W/mk]$	Thermic resistance $\left[\frac{m^2 \cdot k}{W}\right]$
1	OIL OF TRANSFORMER			
	20	866	0,1245	0,000149
	40	854	0,1233	0,000151
	60	842	0,122	0,000155
	80	830	0,12	0,00016
	100	818	0,119	0,000164
2	OIL OF ENGINE			
	40	886,5	0,127	0,000142
	60	871,7	0,125	0,000146
	80	857	0,124	0,00015
	100	842,2	0,123	0,000154

The evolution C, in cogs of saws, is most gated closer to the reality, form to be due the suddenly detachment, in of a parcels parts from deposits.

The mechanism for form's sake of deposit maybe be haggard in five chronological phases: The initial phase represents the period operation of clean apparatus without so that noticed the appearance of the deposits.

The transfer of particles to wall below the act turbulently diffusion, the inertial forces and the thermic field.

The adhesion of the particles exteriorly of transfer of heat by reason of the due adhesion forces of molecular attraction (the forces Van der Walls), the electric his forces capillaries.

The trained the particles deposited is due in special the fricative forces between fluid in flow and the layer of deposits. If the aerodynamic forces the superior by-pathes who of adhesion trained is produced through erosion. The trained of a parcels the big maul of deposits is due the ruptures by reason of the insufficient tenacity in the layer of deposits.

The ageing of the deposits has as the effects a change of chemical his crystalline origin toughness of the layer of deposits may notice is a consolidation, is a crumbliness of this a structure.

4. The influence of the deposits about interchangers

Present the deposits, through their thermic supplementary resistor, has as the effect the decrease global coefficient of shift of heat.

The report between the global coefficients of transfers of heat for the apparatus with deposits and one clean is:

$$C_H = \frac{k_{gl}}{k_{gl}^0} = \frac{1}{1 + k_{gl}^0 \cdot R_d} \tag{4}$$

In the case of a projection interchanger is put the problem if he must considered cleanly or isn't obviously that the apparatus shall abide at capable clean just a short distance after operate or after purification, in the remainder his life existing deposits. From these reason is enforced of habit as the to of a dimension shift of heat to is held the expense and of the resistor of the deposits. In this cases shall result a size a necessary spare surface of heat:

$$\frac{S_d}{S_0} = 1 + k_{gl}^0 \cdot R_d \tag{5}$$

The above-ground due excess of the deposits (fig. 5) be:

$$C_S = \frac{S_d - S_0}{S_0} = K_{gl}^0 \cdot R_d = \frac{1 - C_H}{C_H} \tag{5}$$

The values orientative recommended for the coefficient of above-ground excess by-path:

Cs = 10% the minimum value;

Cs = 15…25 the usual value;

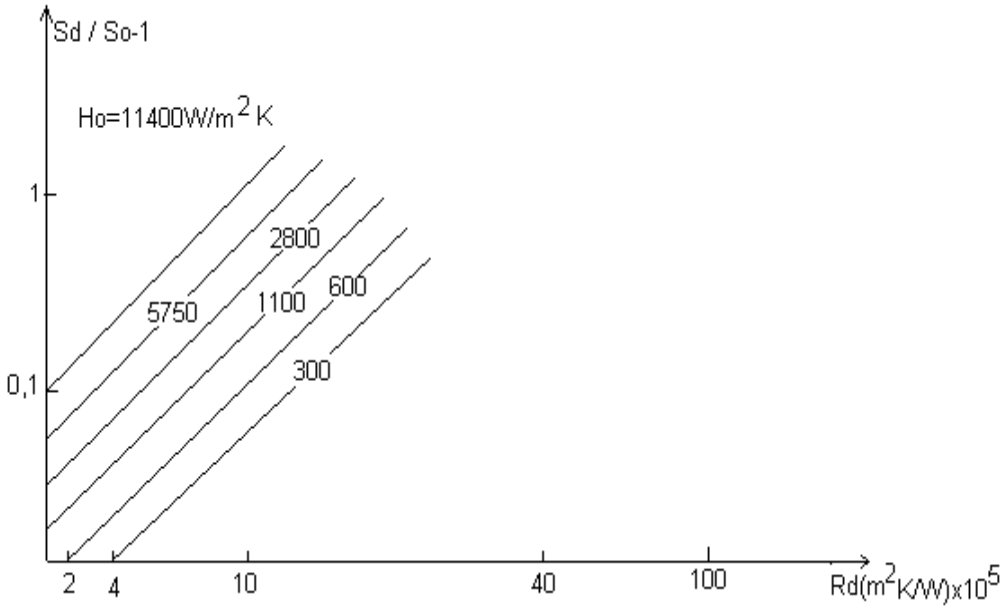

Fig. 5 *The variation of above-ground excess depending on the resistor of the deposits*

C_S = 30…50% the extreme employable value for difficult his cases there where can exist extreme damages if changeable don't touches the performances.

Way no way the over measure he don't shall exceed 50%; In such cases are shall direct to another solutions (contiguous aspersion, two changeable in parallel, etc.

In the of a case the apparatus projected for a global coefficient of transfer of heat, this decrease in the time operation shall have as the effect a diminution of thermic a flux transited in apparatus.

5. Conclusions:

In the case interchangers the surface on which is formed the deposits is the spare surface of heat, the gradient of existing temperature in this zone having an influence as much about the mechanism deposited quotients and about these effect about operation of the apparatus.

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