Part 7

ENERGY SAVING

7.3. New sealing and fire-proof materials for power enterprises

7.3.4. Technology of sealing the rods, spindles of accessories, and shafts of centrifugal pumps

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For providing the hermetic gland joint, it is necessary to prevent the leakage of the working medium, being under pressure. This leakage could occur through the gland in the following directions:

- along the surface of rod (spindle, shaft) and inside part of packing;
- along the wall of gland chamber and outside part of packing;
- through the pores of gland packing itself, if it would be insufficiently packed.

Considering these conditions, the packing must be compressed in the axial direction in such way that the radial pressure, appearing under the influence of axial compression effort, would be sufficient for providing the hermetic surfaces of rod-sealing material and sealing material-wall of gland chamber. And the sealing material should be pressed by axial effort to a degree, eliminating the leakage of the working medium through the material itself.

The axial force, applied to packing, is substantially decreased along the depth of gland chamber in connection with the friction of packing on chamber walls and rod [1—3] as well due to the inner friction in packing itself, appearing at compression. In its turn, friction force of packing on joint face depends on the roughness of rod and gland chamber walls and on the distributions of forces on the depth of gland chamber. Because each packing ring attenuates the force of gland tightening due to the friction forces, compression force of the last rings will be decreased as the depth of gland chamber and the number of installed rings is increased. The reduction of compression force results in the fact that the packing layers, contacting with the working medium, are insufficiently packed. Therefore, the medium can penetrate both through the pores of packing itself and between the rod and packing, creating the gland depressurization.

The qualitative variation of radial effort on rod along the gland length, depending on the total influence of the working medium and the influence of bottom box is presented in fig. 7.15. It should be added that the slope of presented characteristic depends substantially on the material properties, in particular, on the coefficient of side pressure $K_б$: less is $K_б$, steeper is this curve.

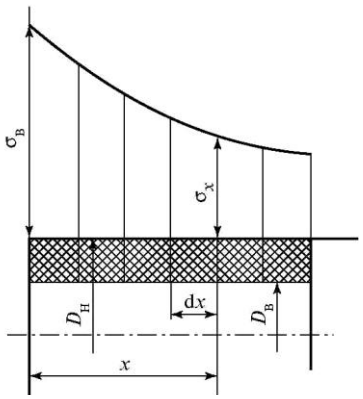

Fig. 7.15. Distribution of axial forces during gland compression

The first rings of packing bear the largest axial load with compression from the side of bottom box (closing sleeve). As the bottom box is moved away, the axial effort is decreased. It is conditioned by friction forces and inner stresses, which appear in packing under the influence of compression.

In this case the radial pressure of packing on rod and chamber walls is changed proportionally to the change of axial compression force and coefficient of side pressure $K_б$:

$$\sigma_y = K_б \sigma_x. \qquad (7.11)$$

If the packing fills the chamber fully and has the high plasticity, that is could be considered as a liquid, in this case the pressure exerted at the gland packing by bottom box wit transfer in all sides with the same force, i.e. $\sigma_y = \sigma_x$ and correspondingly $K_б = 1$.

For providing the hermetic gland and elimination of leakage, it is necessary to have the radial pressure on rod and walls of gland chamber in the point of contact of the working medium and gland packing no less than the working pressure of medium $p_{раб}$:

$$\sigma_y = \sigma_x \cdot K_б \geq p_{раб}\beta, \qquad (7.12)$$

where β is am assurance factor.

Transforming the expression (7.12), we can obtain the minimal axial compression effort, influencing on the gland ring, depending on the working medium pressure, which could secure the hermetic gland operation:

$$\sigma_x = p_{раб}\beta / K_б. \qquad (7.13)$$

The construction of gland chamber renders the considerable effect on the value of clipping of pressed packing together with the coefficient of side pressure. The majority of constructions of gland chambers influencing on the old accessories and centrifugal pumps were fulfilled with slants at the end wall of gland chamber and at the bottom box. Under action of such slant, the side sealing elements feel the additional radial effort (p_{rad}), pressing them to rody.

Using the sealing elements, made of TEG, application of slants results in the excessive compression, first of all, of the first ring and the attenuation of compression below the located rings that can result in the insufficient compression of gland on the whole, the penetration of the working medium in the body of gland packing and the sequent destruction. In addition, TEG is sufficiently fragile. The rings made of it, can be failed under the influence of slope edge of bottom box

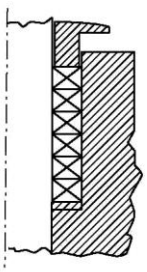

Fig. 7.16. Construction of gland seal of newly designed accessories with packing made of TEG

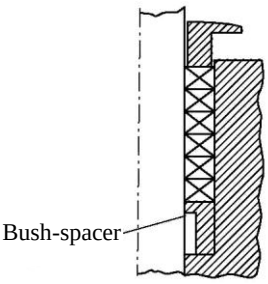

Fig. 7.17. Construction of gland seal of accessories, designed for asbestos-containing packing with seals made of TEG

in the moment of gland tightening that in future can result in the seal failure. Therefore, using TEG "Graphlex" at the old equipment, it is necessary to carry out the cutting of sharp edge of bottom box and to install below the special additional ring with flat foundation under the gland, as it is shown in figs. 7.16 and 7.17.