A design is considered in which there is no sealing element (insert) and the sealing of the lid-body joint is provided by forcible contact between the PTFE lid and the rim of the internal lining in the body. An analysis is presented for the state of stress and strain in the contact between the lid and the internal lining. The mode of strain in the thickness indicates that the lid must be considered as an element in the joint relating to the bolt system and to the insert system, and the values of the lid thickness relating to the systems are dependent on the geometrical parameters. Working expressions are derived for the fractions of the lid thickness relating to the corresponding systems, and this substantially improves the accuracy in calculations on the contact between PTFE lid and body as regards strength and sealing. The analysis can be applied to other insert-free sealed joints when the material is other than PTFE.

PTFE is used as the constructional material for equipment working with corrosive media or in the production of especial-purity substances. The sealing of demountable joints is provided by forced contact between the contacting PTFE surfaces [1]. The forced contact of the sealing surface is provided either by through bolts (Fig. 1a) or by mounting elements for each separate part (Fig. 1b).

Calculations on the demountable joints are based on generally accepted formulas [2, 3]. For example, the forces on the mounting elements (bolts or ties) in the working state are given by

\[ Q_b = Q_t + (1 - \alpha) Q_g \leq m \cdot 0.785 d_b^2 \sigma, \]

while the forces on the sealing surfaces in the working state are given by

\[ Q_s = Q_t - \alpha Q_g \geq [q] F_{ss}, \]

where \( Q_t \) is the total tensioning force in the threaded mounting elements of diameter \( d_b \); \( m \) is the number of mounting elements in a joint; \( Q_g \) is the axial force provided by the pressure in the medium; \( F_{ss} \) is the contact area of the sealing surfaces; \( \sigma \) is the permissible tension in the material of the mounting elements; \([q]\) is the minimum stress in the material on sealing the contacting PTFE surfaces; and \( \alpha \) is the rigidity coefficient of the joint, which is defined by \( \alpha = \Sigma \lambda_b / (\Sigma \lambda_b + \Sigma \lambda_{in}) \); \( \Sigma \lambda_b \) and \( \Sigma \lambda_{in} \) being the sums of the coefficients for the axial compliance of the components relating to the bolt system and the insert system, respectively.

The bolt system in these joints relates to parts for which the forces on them increase with the pressure in the medium, while the insert system consists of parts for which the forces decrease as the pressure rises.

A feature of the design shown in Fig. 1 is that the PTFE lid relates not only to the bolt system but also to the insert system because part of its thickness is loaded as the working medium pressure increases, while part is unloaded.

When the joint has been assembled and the fastening elements have been tensioned with force \( Q_t \), compressive stresses \( \sigma_i \) arise in the zone of contact between the lid 3 with flange 5 and the rim 1, whose distribution over the width of the contact surface and the lid thickness are taken as uniform (Fig. 2): \( \sigma_i = Q_t / F_{II} \), where \( F_{II} \) is the area of the contact surface between the lid 4 and flange 3.

Under working conditions, there is an axial force due to the pressure \( Q_g = \pi D_{av}^2 p_g / 4 \), and the stress varies over the thickness of the lid. On the rim side it is reduced, while on the steel flange side it is increased.

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AXIAL COMPLIANCE IN A FLUOROPLASTIC COVER FOR A PRESSURIZED APPARATUS

Consider the variation in stress over the thickness of the lid \( h \) on the basis that there is a single force \( Q_g \). We assume that the stress \( \sigma_z \) varies over the thickness of the lid in response to this force as the inverse square of the distance \( z \) (by analogy with the action of a load on an elastic half-space [4]):

\[
\sigma_z = -\frac{3Q_g}{2\pi(z + B)^2},
\]

in which \( z \) is the current thickness of the PTFE lid and \( B \) is the geometrical parameter.

Fig. 1. Design schemes for bodies of PTFE units with through ties (a) and with fastening elements for each separate unit (b): 1) rim of internal lining; 2) internal PTFE lining; 3) PTFE lid; 4) flange of steel external shell; 5) mounting flange; 6) tie; 7) pin (bolt); I and II) sealing nodes; \( p_g \) pressure of medium.

Fig. 2. Design scheme for sealing unit (a) and stress distribution in thickness of lid (b): 1 and 2) rims of PTFE jacket and steel jacket; 3) mounting flange; 4) lid.