



Increasing Reliability of The Improved Machines and Equipment : Determination Of Productivity Criteria

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ABSTRACT

The article is dedicated to study the destruction reasons of hermetic elements in butterfly valves and to figure out the various factors cause vulnerabilities that makes an obstacle for compactness as well as reliability of hermetic elements during the operation. The overall methodology studied and new constructive proposes suggested to make an improvement on hermetic elements in this particular, new constructive approaches have been realized for valve seats. At the same time, a new formula has been produced to choose the required materials and to seat them onto each other.

Keywords: butterfly valve, longevity, force, hermetic element, loss in force, compactness

Received 26.08.2017

Revised 29.09.2017

Accepted 11.11. 2017

INTRODUCTION

Nowadays, in the name of rapid developments in technology and technique, high requirements to connecting devices used in industry requires them to be deeply studied and improve the results which has been gained during the research.

For time being, valves belonging to connecting devices are widely used in oil and gas industry. Such kind of connecting devices' hermetic elements which works under high pressure reduce the reliability of valve faster than usual by losing its workability.

Despite of resources of nowadays technology, friction and its negative consequence as weariness is still remaining in moving parts of valve. Friction occurs in contact surfaces of valve's moving parts and causes loss of that pair on the basis of the affecting mechanism.

Butterfly valve was chosen by us as a research object and possible scientific findings were obtained at the result of researches carried out on it.

Studies show that some of the valves lose their reliability in comparison with the date shown in their technical passport by the effect of corrosion, erosion, hydro-abrasive weariness during operation[1]. As known [2], the main reason of abrasive weariness is a huge amount of solid (sand, etc.) particles within product which pass through vales. The particles that fall into the moving parts cling the surface and scratching the surface of hermetic element that provides compactness leading to a decline in longevity as a result of premature loss of workability of hermetic element. After a while hermetic element cannot prevent the rate of fluid and therefore leakage occurs due to gaps increment in hermetic surfaces.

MATERIAL AND METHODS

Valve's hermetic element is subject to compression at the expense of working pressure and unequal distribution of relative pressure (occurs due to this compression) observes from hermetic element's edges to center. Thus, relative pressure in contact surface of rubber seal which placed between valve's main disc and metal seal affects lesser to edges whereas it affects more toward the center. Therefore, distribution of relative pressure on the contact surface of hermetic elements will be smaller in edges and will be higher toward the center. As a result of unequal relative pressure distribution across the hermetic element width, hermetic element's part which subject to pressure will be also subject to intrinsic tension

in α -line. Consequently, element's material will be exhausted and due to that hermetic element will be useless (Figure1; Figure 2)

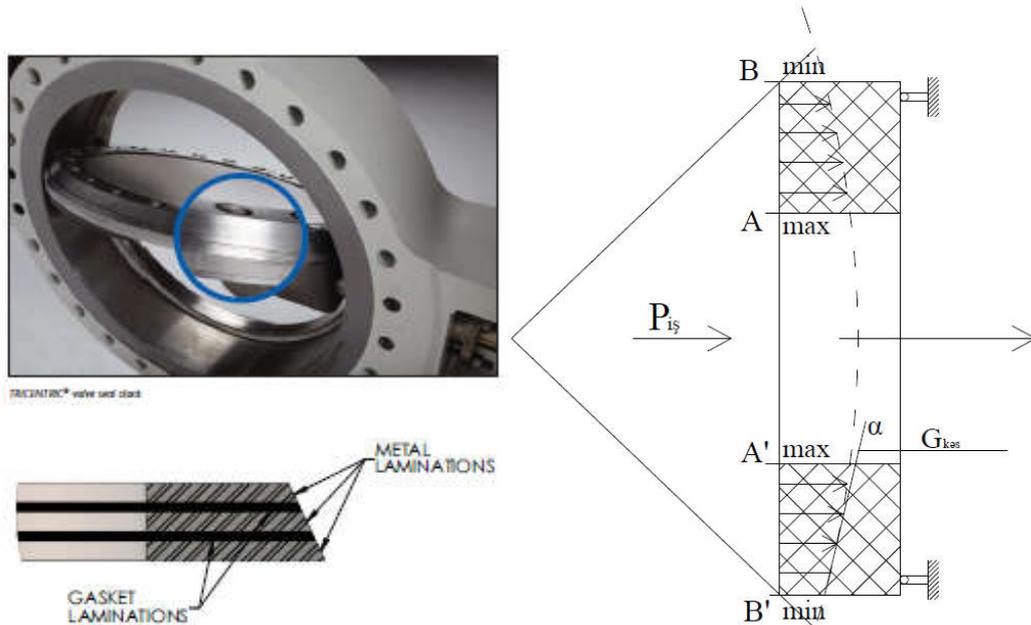


Fig.1

Fig. 2

Improvement of connecting devices' hermetic elements can be implemented in several ways. Heretofore, different ways have been considered to solve this issue, and various ideas as well as methods have been put forward for the improvement process. For instance, in butterfly valves convexity of valve's disc, ie its half-circle shaped can be demonstrated as an example considering comparatively distribution of working pressure across the surface of the disc [3]. Despite the fact that this constructive modification can limit the pressure to be released equally, however equal distribution of pressure on the edges of disc is not fully guaranteed, which in its turn causes non-symmetric deformation of the hermetic element. For this reason, deforming surfaces of hermetic element subject to cutting tension through interior cross- section. As a result, hermetic element exhausts under periodic variable force and being broken/ cut off from deformed parts through internal cracks. Thus, valve loses its workability.

Other vulnerabilities of these types of valves include the fact that their regulation feature is limited to 30-80 degrees rotation of disc, instability of disc motion and it is subject to turbulent flow of stream can be an example. They also cause prematurely loss of hermetic element and loss of valve workability accordingly.

That is why during operation of such kind of valves, material which hermetic element is being made should be properly selected, fitting process in its seat should be properly maintained and shape as well as dimensions of the part should be constructed according to the required parameters of seat where it is being setted.

Considering relative pressure unequal distribution in the hermetic element of researched object causes the loss of workability, therefore the main purpose is dedicated to improve reliability and workability of butterfly valve by changing the form of hermetic elements and re-construct a seat for these elements.

It is possible to achieve the reasonable result by the following methods.

- Loss in force
- Change the construction of hermetic elements
- Change the construction (or re-construct) of seat according to geometric parameters of the improved hermetic elements.

Hermetic element of butterfly valves consists of both rubber and metal rectangle rings. However, these rings provide the compactness when fitting to each other, rubber seal is subjected to cutting tension due to uneven distribution of relative pressure (inside of rubber hermetic element) which squeeze them to each other. Eliminating the mentioned tension will ensure longevity of hermetic element. As seen from Figure 2, cutting tension occurs along " α " line.

It is recommended to separate the rectangular hermetic element of valve into two parts by delimiting to triangular and trapezoidal flatness elements (Figure 3) in order to solve the problem set by us. Material hardnesses of proposed hermetic element to be determined by the following formula.

$$HB1 > HB2 \quad (1)$$

Where,

HB1 - material of trapezoidal element;

HB2- material of triangular element.

Trapezoidal element has got centerpiece running considering the triangular element is the first deformable element during the influence of working pressure on the basis of formula (1). Consequently, in hermetic elements' seats due to the triangular and trapezoidal elements are compressed onto each other where numbness occurs over contact surfaces, therefore the equal distribution of relative pressure is almost ensured. As a result of the above mentioned process, longevity and workability of hermetic element are being increased.

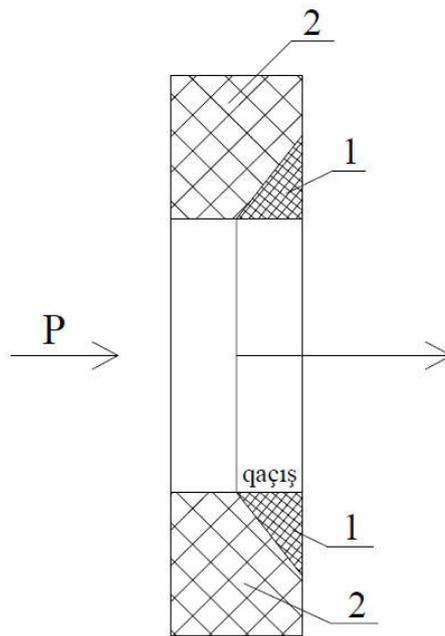


Fig. 3 the rectangular hermetic element of valve into two parts by delimiting to triangular and trapezoidal flatness elements

RESULT

1. Hermetic element destruction of butterfly valve was determined and methodology for its enhancement was given accordingly.
2. Formula was suggested to chose the materials of parts and ensuring the workability in improved hermetic element

DISCUSSION

For time being, valves belonging to connecting devices are widely used in oil and gas industry. Such kind of connecting devices' hermetic elements which works under high pressure reduce the reliability of valve faster than usual by losing its workability.

Despite of resources of nowadays technology, friction and its negative consequence as weariness is still remaining in moving parts of valve. Friction occurs in contact surfaces of valve's moving parts and causes loss of that pair on the basis of the affecting mechanism.

Improvement of connecting devices' hermetic elements can be implemented in several ways. Heretofore, different ways have been considered to solve this issue, and various ideas as well as methods have been put forward for the improvement process. For instance, in butterfly valves convexity of valve's disc, ie its half-circle shaped can be demonstrated as an example considering comparatively distribution of working pressure across the surface of the disc [4]. Despite the fact that this constructive modification can limit the pressure to be released equally, however equal distribution of pressure on the edges of disc is not fully guaranteed, which in its turn causes non-symmetric deformation of the hermetic element. For this reason, deforming surfaces of hermetic element subject to cutting tension through interior cross- section.

As a result, hermetic element exhausts under periodic variable force and being broken/ cut off from deformed parts through internal cracks. Thus, valve loses its workability.

Scientific research work carried out by P.h.D. J.N. Aslanov and Ph.D student Khalig Mammadov at Azerbaijan State University of Oil and Industry in the department of Oil-Gas equipment as well as discussed in Scientific Seminar and meeting of the department. The main provisions of the scientific research work is registered and protected by Copyrights Agency of Azerbaijan Republic.

CONCLUSION

At the work, hermetic element destruction of butterfly valve was determined and methodology for its enhancement was given as well as a new formula was suggested to choose the materials of parts and ensuring the workability in improved hermetic element

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Citation of this Article

Aslanov Jamaladdin Nuraddin, Mammadov Khalig Sadig. Increasing Reliability Of The Improved Machines And Equipment. Determination Of Productivity Criteria. Bull. Env. Pharmacol. Life Sci., Vol 7 [1] December : 55-58
