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# THE TECHNOLOGICAL PROGRESS – A VERIFICATION PROCEDURE OF CENTRIFUGAL PUMPS INDUSTRIAL POLLUTION

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***Abstract:*** *The air quality standards ask that every factory which works with toxic or risky fluids should have a control strategy, in order to be applied in the dynamic equipments. The centrifugal pumps which manage these fluids or gases have in their structure mechanical face seals, which seal off the pump interior from the environment. The mechanical face seal building up technology represents the best verification procedure for the rotary equipments. This paper presents mechanical face seals projects and the liquids mechanical face seal systems applying procedure.*

***Key words****: air quality, mechanical face seal, advanced technology*

## 1. INTRODUCTION

Inside of the chemical products manufacture processes, the toxic fluids have to be removed from one place in the other because of the high pressures and temperatures. The auxiliary products which result from the chemical reactions have to be removed efficiently and safely too. The air protection severe standards impose sealed advanced technologies elaboration for these difficult applications, in liquids case and also for the gases.

EPA has been established standards for the maximum admitted emission of the volatile organic compound for 1000 pp equipment. Although, others cancerous compounds as benzene have a limit at 1 ppm by the OSHA standards. When the emissions level is exceeded, equipments repairs are imposing. In order to respect these severe quality standards, every factory needs to adopt a control strategy, which should be applied to its equipments and dependent to the technology, economy and feasibility.

The typical techniques used for the risk and toxicity high level emission control contain the following actions:

1. The contact and mechanical face seal systems revision and re-technology;
2. The installation and configuration of some liquids mechanical seal systems in order to prevent the direct contact and the leakages flow;
3. The installation and configuration of dry mechanical seals for the gases or steam applications.

All these control methods will substantially decrease the factory noxious emissions and they will improve the safety in the equipments exploitation. Lots of the mechanical seal systems which are used today and will be discussed in this paper, were not available some

years ago. Today we can expect from a mechanical seal system to protect more efficiently the environment.

## 2. THE MECHANICAL FACE SEAL PROJECT

Most mechanical seal systems used in the petrochemical industry are mechanical face seals. Usually, the two frontal plane faces which are parallel disposed (the mechanical face seal) succeed in retaining the process liquid inside the equipment. Both faces are in a static contact, while the shaft is rotating. During pump working, the cooling and the lubrication are important in order to achieve a satisfying performance. The heat evolved by the primary mechanical face seal must be carried off. If the heat is not eliminated, some damages may appear because of the evaporation process. For many pump equipments, one simple circulating hole is enough to eliminate the heat produced through friction (fig. 1).

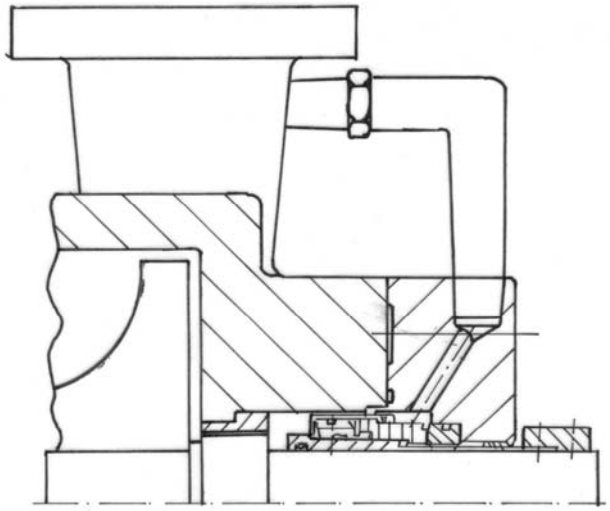

**Fig. 1** *Seal for centrifugal pumps*

The mechanical face seal project has an important role in decreasing the heat produced through friction. First projects were not balanced and they were used only for the small seal pressures. This was because the sealed liquid pressure was carried by the interstice pressure. The balanced mechanical seals were developing in order to decrease the pressure supported by the primary mechanical seal and also in order to increase the working limits. The primary mechanical seal surfaces have been initially projected as plane surfaces (fig. 2A). In time, graphite combined with tungsten carbide began to be used in the construction of the primary mechanical face seal, the maximum limit of the pressure multiply speed product growing to the 175 bar m/s value.

In order to extend the working limits and especially for the high temperatures liquids sealing, the primary mechanical seal project needed to be changed. The heat evacuation was accomplished through some semi-circular holes on a seal ring surface (fig. 2B).

The complete exclusion of the direct contacts during the friction process is accomplished through some holes in the spiral (fig. 2C). This project was necessary for the primary mechanical seal working conditions in dry regime, such as gases centrifugal compressors.

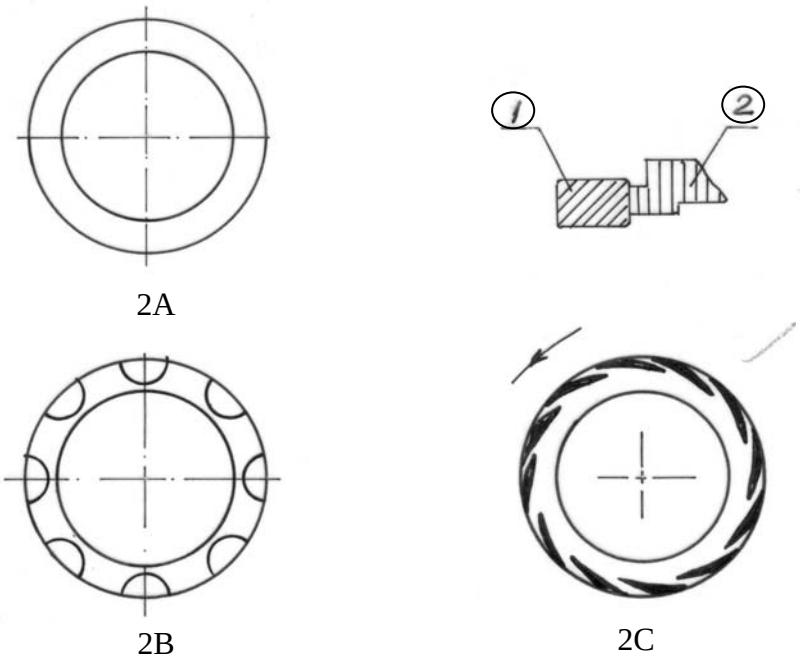


**Fig. 2** *Shapes for the friction surfaces*

## 3. USING NEW TECHNOLOGIES

Once new standards have been adopted, new terms and definitions have been appeared. The Air Quality Management Department from South California asks the best technologies for the chemical equipments. We can talk about two terms in this manner:

**a.** Technological feasibility

In pumps case, technological feasibility is realized by the sealing system, which has a steam evacuation device or a recapture one.

**b.** Obtained through practice

In pumps case, the system must have two sealing devices, a mechanical seal devices tandem or a device which is equivalent with an approved technical inspection and a well established maintainable program. Any applying which seals liquids or gases is dependent by the sealing system shape. The system shape has always been playing a very important role in the highly dangerous emission control. Four principles are available:

- One seal device, fitted inside the system chamber;
- One seal device, fitted outside the system chamber;
- Double seal devices;
- Seal devices in tandem.

Nearly 75% from the whole seal systems use one device inside the chamber, because this is the most economic system in industry.

This system can be used for dangerous fluids, along with the advantage that the seal device is isolated and the system part which has contact to the atmosphere has a steam removing or recovering device. The atmospheric air is stopped to enter in the chamber by a secondary mechanical seal – variable bush type. Any emission is conducting to the steam evacuation or recovering system through some easy aspiration.

The double seal devices have generally two primary mechanical seals, placed back to back, forming a separate chamber from the process liquid. The space between them contains a buffer liquid at a higher pressure than the process liquid.

A non-toxic buffer liquid film is forming, having very good lubricating properties for the friction/sealing surfaces. Knowing that the buffer liquid has a higher pressure then the process liquid, the environment is protected from the toxic leakages risk. This seal device type is used in benzene product or in other toxic compounds cases. A double seal device is very useful also for the low lubrication properties liquids sealing. This system needs a buffer liquid circulation in order to eliminate the not wanted heat, generated by the primary mechanical seals.

The tandem seal system is made by two seal devices, being orientated in the same direction. The inner device supports the whole product pressure and the buffer liquid can be re-circulated for cooling through the second device chamber. This last device is a static one. If the inner device declines, the second device will have to support the whole pressure until the dynamic gear will be stopped.

Both the tandem systems and the double systems have the practical safety guarantee, as long as in the factory a monitoring and maintaining program is adopted.

In many cases, the liquid or toxic steam looses through a mechanical face seal system are the result of a disorganized process, of a wrong assembly, of a wrong seal or system devices choices, or of a primary mechanical seal unfit materials choice. Today, the advanced solutions for the sealing system exclude these problems. The seal system “cartouche” are the most used in the existing equipments. Their performance is not affected by the pressure changes. The inner device and the contact surface ring are projected to resist to high pressures in the external or inner diameter. The buffer liquid between the primary mechanical seal surfaces may have a pressure equal or higher then the atmospheric one. This can permit a dryer working of the pump during the sealing device lubrication. The “cartouche” type seal eliminates also all the assembly errors.

All the mechanical face seals - “cartouche” type are tested before the installation. This solution has become very much utilized at the ANSI and API pumps.

## 4. CONCLUSIONS

The air quality severe standards suppose adopting these advanced technologies in order to reduce and eliminate industrial pollution. This sealing systems generation has been successfully implemented at pumps, compressors, ventilators, etc. The result consists in the elimination of contact friction and of the heat resulted from friction. Its usage advantages are dynamic gears reliably degree increasing and also the environment protection increasing, without major changes.

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