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DESIGN AND DEVELOPMENT OF INTERNAL MECHANICAL SEAL FOR CHEMICAL PROCESSING CENTRIFUGAL PUMP.

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Abstract: A mechanical seal is a device, which helps joint systems or mechanisms together by preventing leakage. Before World War II it used gland packing which is replaced by external mechanical seal. These type of seal utilized in rotating equipment, such as pumps, mixers, blowers, and compressors. When a pump operates, the liquid could leak out of the pump between the rotating shaft and the stationary pump casing. Since the shaft rotates, preventing this leakage can be difficult. The elements are both hydraulically and mechanically loaded with a spring or other device to maintain contacts. There is also problem with external mechanical seal so we replace it with internal mechanical seal for non-metallic chemical processing pumps.

Keywords: Mechanical Seal, Rotary Parts, Stationary Parts.

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INTRODUCTION

A mechanical seal is a device which helps join systems or mechanisms together by preventing leakage (e.g., in a plumbing system), containing pressure, or excluding contamination. A seal may also be referred to as packing. Mechanical seals are simply another means of controlling leakage of a process where other means are deemed to be less capable of performing the task adequately. A mechanical face seal is an important component of variety of pumps used in chemical, petrochemical and process industry. The primary function of a mechanical seal is to prevent leakage of the process fluid from the pump housing and shaft to the environment. The factors that affect the performance of a mechanical seal to leak are friction, wear and its thermal characteristics. Improving upon the thermal characteristics of a mating ring in a mechanical seal would enhance its performance.

II. Objectives of research

- To increase temperature capacity of mechanical seal.
- To increase pressure capacity of mechanical seal.
- To reduce the vibration effect on mechanical seal.
- For minimizing loss of product.
- To minimize leakage.
- To prevent toxic fluids escaping to atmosphere.
- To reduce power loss.

III. Parts of internal mechanical seal

- ❖ Rotary part of seal.
- ❖ Stationary part of seal.

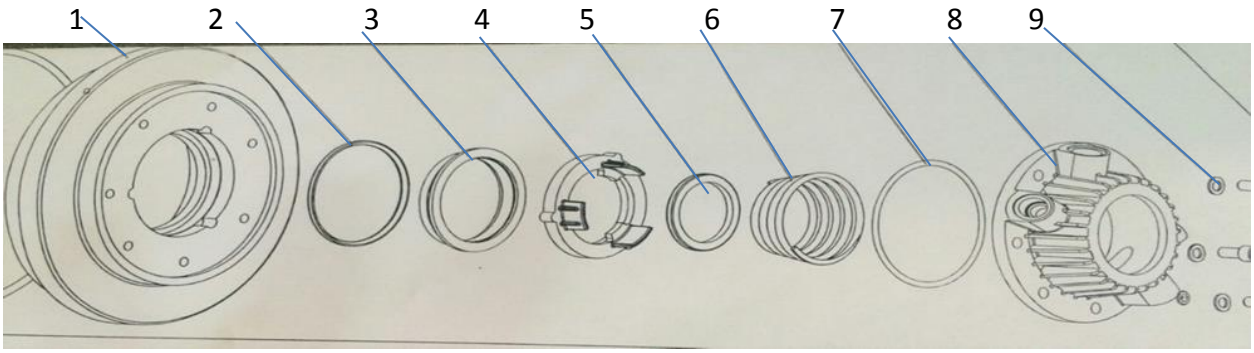

Fig. I Assembly of mechanical seal

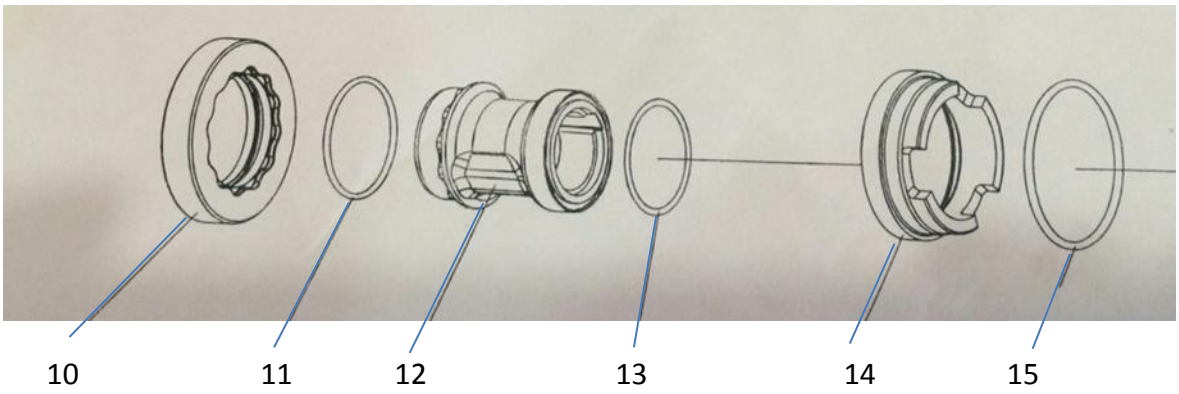

Fig. II Main parts of Mechanical seal

Sr. No	Part name	Sr. No	Part name
1	Back plate	9	Screw
2	O-ring	10	Rotary seal ring
3	Thrust ring	11	O-ring
4	Stationary ring holder	12	Shaft sleeve
5	Pressure/tension relief ring	13	O-ring
6	spring	14	Stationary seal ring

7	O-ring	15	O-ring
8	Seal cover		

TABLE I: No. of parts and parts name

IV. Main parts of seal

1. Shaft sleeve: Made by S.S and after coated with pvdf. 6mm coating done on shaft because it used inside the pump casing if there is no coating of pvdf than S.S. can affected by chemical. Chemical reaction done in shaft sleeve and chemical.

2. Rotating seal ring: Made by SSiC. Provide pattern as shown in figure is for self-locking with shaft sleeve.

3. Stationary seal ring: Made by SSiC. Provide slots for locking with stationary seal ring holder.

4. Stationary seal ring holder: Made by PVDF material. It usde to lock the stationary seal ring. If it is not usde than stationary ring also rotate with rotating seal ring.

5. Thrust ring: Made by SSiC material. It used to reduce vibration effect due to fluctuation in motor shaft speed.

6. Pressure/ Tension relief ring: Made by PVDF material. When temperature rise suddenly on the seal face which is transferred to pressure/tension relief ring. Due to heat transferred PVDF ring melted and seal get free from pressure. So due to this ring seal face cannot damage.

7. Spring: Made by spring steel and coated with Pvdf material. Used for give proper sealing effect.

8. Seal cover: Made by Pvdf material. Whole seal is fixed inside the seal cover.

V. Mathematical calculation of internal seal.

1. BALANCE RATIO (B)

$B=\{D_0^2 - D_b^2 | D_0^2 - D_i^2\}$

$=\{84^2 - 59^2 | 84^2 - 77^2\}$

=3.172

2. FACE AREA, A (mm^2)

A=$\frac{\pi}{4}(D_0^2 - D_i^2)$

=$\frac{\pi}{4}(84^2 - 77^2)$

=885.14

3. SPRING PRESSURE (MPa)

P_{sp}= $\frac{F_{sp}}{A}$

= $\frac{539.37}{885.14}$

= 0.61 N/ mm^2

4. TOTAL FACE PRESSURE,P_{tol} (MPa)

P_{tol} = ΔP * (B-K) +P_{sp}

= 0.8 * (3.172-0.5) +0.61

=2.75 MPA

5. MEAN DIAMETER, D_m

$D_m = \frac{D_0 + D_i}{2}$

= $\frac{84+77}{2}$

=80.5 mm

6. RUNNING TORQUE, T_r (N-m)

T_r=P_{tol}*A*f*$\left(\frac{D_m}{2000}\right)$

= 2.75*885.14*0.2*$\frac{80.5}{2000}$

= 19.6 N-m

7. STARTING TORQUE, T_s (N-m)

T_s=T_r*4

=78.

8. SEAL FACE GENERATED HEAT, H (kW)

H= $\frac{T_r*N}{9548}$

= 19.6*1440/9548

= 2.956 kW

9. HEAT SOAK,Q_{hs} (KW)

Q_{hs}= U*A* D_b*ΔT

=$4.5*10^{-6} * 885.14 * 3.172 * 275.1$

=3.48 KW

10. TEMPERATURE RISE IN INTERNAL SEAL FRCE DUE TO HEAT GENERATED IN ONE SECOND T_{rs} ℃

T_{rs}=$\frac{HEAT\ GENERATED\ H}{SPECIFIC\ HEAT\ C_p*WEIGHT}$

=$\frac{2956}{243*1.8}$

= 2.21 ℃

Comparison	Internal seal	External seal
Cost INR	35000	14000
Life	6 to 8 months	Max 6 weeks
Temperature rise in one second ℃	2.21	3.25
No. of components	15	6
Maintenance	Pvdf parts like Thrust ring and seal ring holder can replaced	Want to replace whole seal

VI. Conclusion

- Back pressure problem in external mechanical seal is solved by the design of internal mechanical seal.
- Maintenance is reduced.
- Life increased.
- Temperature rise is less than external seal.
- Due to increase in life it reduce the production loss and due to less leakage it also reduce the chemical reaction effects in environment.

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