International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 6 Issue 06, June - 2017

Improving Performance of Water Cooling Pump in Oil and Gas Production Unit

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***Abstract* - Pump as one of the tools that play an important role in production process of oil and natural gas. Operational parameters such as pump's head and capacity, static and dynamics pressure, Net Positive Suction Head Available (NPSHA), and cavitation. These parameters effect pump efficiency. To rise the value of NPSHA on this system, two alternative ways can be performance, i.e; by increasing the level of or by static pressure at the surface of the water. In this work, effort of adding static pressure of cooling water in the Cooling Water Expansion Tank is performed. The aim is to figure out its effect on improving Best Efficiency Performance (BEP) of the cooling water pump. The result shows that the pump BEP improves with addition of static pressure in cooling water tank. The improvement is due to NPSHA increases with increasing the static pressure.**

Keywords - Improving; Performance, Pump.

I. INTRODUCTION

Pump as one of the tools that play an important role in production process of oil and natural gas. The pump is a machine that is used to move liquids from one place to another, through a medium pipe (channels) by adding energy to the fluid being removed and be sustained. The pump operates by holding differential pressure between inlet (suction) and outlet section (discharge). In other words, the pump function convert mechanical energy from a power source (driving) into fluid power, where energy is useful to drain the fluid and overcome the barriers that exist throughout the flow.

Based on the way to move and energizing the fluid, the pump can be classified into Positive Displacement Pump and Non-Positive Displacement Pump [1]. Operational parameters such as pump's head and capacity, static and dynamics pressure, Net Positive Suction Head Available (NPSHA), and cavitation. These parameters effect pump efficiency.

Centrifugal pumps, one of many types non positive displacement pump, have been used widely in commercial, industrial, as well as in power plant. In order to minimize energy consumed, it is importance to operate a pump at its best efficiency performance. Many works on evaluation of pump performance have been conducted experimentally and simulation [2], [3], [4], [5].

To rise the value of NPSHA on this system, two alternative ways can be performance, i.e; by increasing the level of or by static pressure at the surface of the water. In this work, effort of adding static pressure of cooling water in the Cooling Water Expansion Tank is performed. The aim is to figure out its effect on improving Best Efficiency Performance (BEP) of the cooling water pump.

II. METHODOLOGY

The BEP of the pump before and after static pressure addition are compared. In order to obtain the BEP, it is required to calculate total head, head loss, NPSHR and NPSHA, and shaft power required. The calculations are performed with equations as follows

Total Head

$$H = h_a + \Delta h_p + h_s + \frac{v_d^2}{2g} \quad (1)$$

Head loss due to friction and fitting

$$h_f = \lambda \frac{L}{D} \frac{v_d^2}{2g} \quad (2)$$

$$h_{fit} = f \frac{v^2}{2g} \quad (3)$$

Hydraulic power

$$P_w = 0.163.\gamma.Q.H \quad (4)$$

Shaft power required

$$P = P_w \frac{P_w}{\eta_p} \quad (5)$$

NPSH Available id defined from head of liquid at the suction side of the pump (equivalent to the absolute pressure on the suction side of the pump) minus the saturated vapor pressure of the liquid in place. Meanwhile, NPSH required is a pressure head and equal to the pressure drop. In order to avoid evaporation of liquid, the pressure at the inlet of the pump, minus the pressure drop in the pump, should be higher than the vapor pressure of the liquid.

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III. RESULTS & DISCUSSION

Fig. 1 shows correlation between pump capacity and static pressure

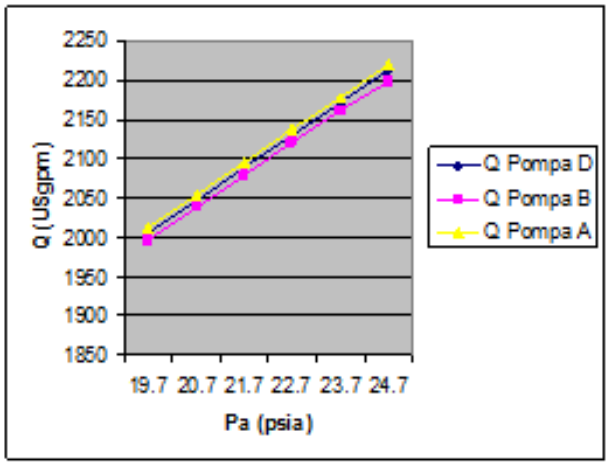

Fig. 1. Q-Pa curve

It can be seen that increasing static pressure (Pa) in the tank increases capacity (Q) of pump A, B, and D.

Fig. 2 and Fig 3 present effect of static pressure (Pa) on discharge pressure (Pd) and suction pressure (Ps), respectively

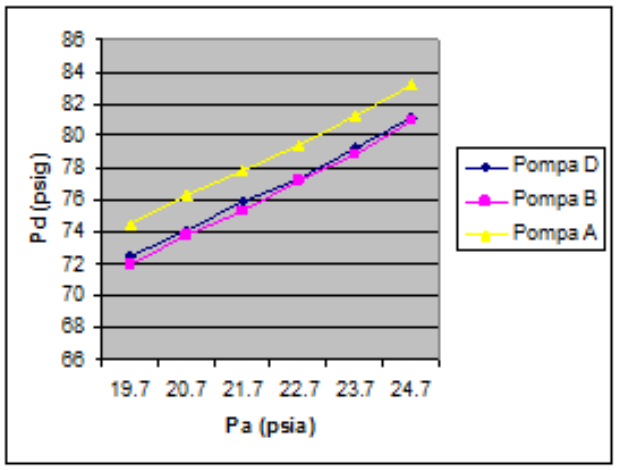

Fig. 2. Pa-Pd curve

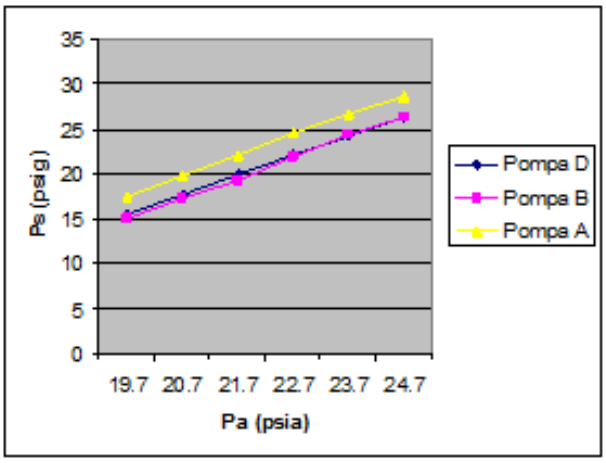

Fig. 3. Ps-Pa curve

The graphs indicate that both discharge and suction pressure improve as increasing static pressure of water cooling tank.

Eventually, effect of static pressure addition on the BEP is shown in Fig. 4. The addition of static pressure able to improve pump's effiency to 81.2%. The BEP graph also indicates that the pump is ready for use. This condition can also figure out from heat exchanger temperature of gas compresor unit which is shown in Fig. 5

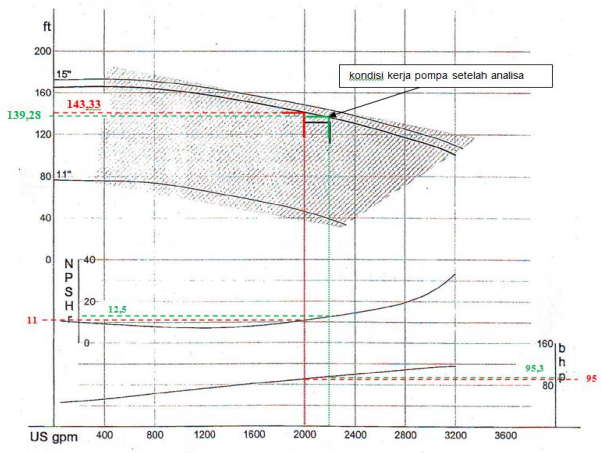

Fig 4. Pump's Performance after additional NPSHA

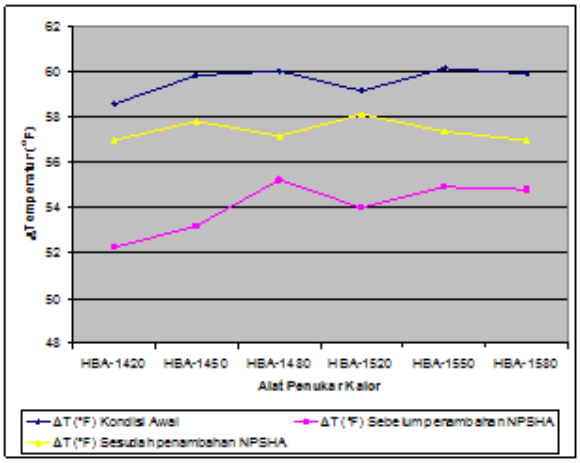

Fig. 5. Temperature of gas compressor heat exchanger

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IV. CONCLUSION

The pump BEP improves with addition of static pressure in cooling water tank. The improvement is due to NPSHA increases with increasing the static pressure. The shortage of NPSHR can be handled with increasing the supply of gas into the tank by turning the screw on the regulator valve.

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