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Registration of the Characteristic Curves of Caned Pump

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ABSTRACT
The paper reports investigation fixed speed caned pump Characteristic which includes flow, pressure, power consumed and pump efficiency under condition of atmospheric pressure and temperature in ShuwaikhKuwait.
The experimental procedure will run on G.U.N.T test rig RT 396 which permits the determination of characteristic curves – of a centrifugal pump by change the flow rate using a motorized control valve. Four digital displays show the speed and the electrical power consumption of the pump, the volumetric flow and, the degree of opening (in percent) of the control valve. During operation and registration of the characteristic curves.
The results from the testing rig unit are compatible with that from experimental calculations with 5 % deviation, which mean that the test rig is appropriateness.

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I. INTRODUCTION

The pump used here in research is a centrifugal pump, designed as a caned pump (see Fig. 1). Its applications are as follows:

- Handling of water in the building services.
- Industrial and agricultural sector.
- Pressure increase circulation of hot/cold water in heating and air conditioning systems.
- Industrial washing systems.

Caned centrifugal pumps are available in an enormous range of designs in terms of materials, seals, types of construction and installation sizes. Fig (1). Generally centrifugal pumps are one of the most common types of pumps. Centrifugalpumpsare characterized byacompact designandare relatively simple structure and donot include any moving components which are readily subject to wear.

Fig (1) Caned centrifugal pumps

II. LITERATURE SURVEY

1.1 A Review On Improvement Of Efficiency Of Centrifugal Pump Through Modifications In Suction Manifold

A centrifugal pump operated at constant speed delivers any capacity from zero to maximum depending on the head, design and suction conditions. The operating pressure of the system is a function of the flow through the system and the arrangement of the system in terms of pipe length [1].

1.2 PreImproving the Hydraulic Efficiency of Centrifugal Pumps through Computational Fluid Dynamics Based Design optimization.

THECOMPUTATIONAL TECHNIQUE
In this section, we shall describe the general structure of the computational technique used in the optimization that we apply to a specific system in section III. We shall present this general case first and then indicate briefly how the results will simplify for our special cases [2].

1.3 A Experimental Study on Centrifugal Pump to Determine the Effect of Radial Clearance on Pressure Pulsations, Vibrations and Noise .

Centrifugal pump is one of the basic and a superb piece of equipment possessing numerous benefits over its contemporaries. The main advantages of a centrifugal pump includes its higher discharging capacity, higher operating speeds , lifting highly viscous liquids such as oils [3].

1- Caned centrifugal pumps working principal

Centrifugal pumps have a spiral-shaped housing containing an impeller fitted with blades. With caned pumps the impeller is mounted directly on the motor shaft. The fluid enters the impeller via the intake fitting andisacceleratedintocircularpathbyarotating impeller. The centrifugal force spins the fluid outwards in a radial direction so it reaches the spiral housing and then the pressure fitting. The spiral housing acts as a spiral manifold. The fluid is decelerated in this manifold. TheKineticenergystoredinthefast-flowingfluidis converted into static pressure energy. The fluid leaves the pump at high pressure via the pressure fitting.This high pressure is the so-called pump head. Thefluidistakeninattheintakefitting.Asthefluid is accelerated to a high speed in the impeller, part of the static pressure energy is converted into kinetic energy. The impeller inlet is thus subject to relatively low static pressure, which is transferred to the intake fitting. This low pressure is the so-called suction head.

III. TEST RIG

The pump and valve test rig Fig (2) permits the determination of characteristic curves of a centrifugal pump by using of a motorized control valve to regulate the flow rate. Four digital displays show:

- Position of electrical control valve (1)
- speed (2)
- electrical power (3)
- Flow rate (4).

The unit is equipped with four pressure gauges:

- Differential pressure gauge (5).
- Differential pressure gauge (6).
- Deliverypressure gauge (7).
- Suctionpressure gauge (8).

Fig (3) Test rig

IV. CANED PUMP CHARACTERISTIC

The total head TH of a pump is the mechanical work transferred by the pump to the medium pumped, normal water density (ρ = 1000kg/m^3) and specific gravity (= 9810 N/m^3). The totalhead TH is measured astheincreaseintheusablemechanicalenergyof water pumped between the inlet and outlet of the pump. The unit of thetotal head is the meter. Despite this unit, the head must never be taken to signify a length, the total head units is energy per unit weight i.e.j/N.

Symbols:

TH Total head in m
h_d level of delivery of pump in m
$h_s$level of suction of pump in m
p_dStatic pressure in outlet cross-section of pump in Pa
p_sStatic pressure in inlet cross-section of pump in Pa
v_dFlow speed in outlet cross-section of pump in m/s
v_sFlow speed in inlet cross-section of pump in m/s
ρDensity of fluid in kg/m^3= 1000 kg/m^3 for water
g Acceleration of gravity = 9.81 m/s^2
Q Volumetric flow rate m^3/s

Total head TH consists of:

$h_d - h_s$: Difference in height levels of inlet and outlet cross-section of pump.

$\frac{p_d - p_s}{\rho \times g}$: Difference in pump pressure of pumpedmediumbetweeninletandoutlet

$\frac{v_d^2 - v_s^2}{2 \times g}$: Difference in speed levels of pumpedmediumbetweeninletandoutlet

These yield the Total head equation for a pump as:

$$TH = h_d - h_s + \frac{p_d - p_s}{\rho \times g} + \frac{v_d^2 - v_s^2}{2 \times g} \qquad (1)$$

$h_d - h_s$= 0.36 m for the experiment rig
$v_d = Q \div 0.00196$inm/s (outlet area = 0.00196 m2, d = 50 mm).
$v_s = Q \div 0.00332$inm/s(inlet area = 0.00332 m^2, d = 65 mm).

TheTotalefficiencyof pump isdefinedastheratio of the hydraulic power HP to the electrical power consumption EP.

$$\eta = \frac{HP}{EP} \times 100 \quad \% \quad (2)$$

Hydraulic power in HP w is calculated using:

$$HP = \rho \times g \times Q \times TH \quad (w) \qquad (3)$$

V. EXPERIMENTAL PROCEDURE

4-1 startup;

1. Switch on the electric power.
2. Adjust the pump speed to 2700 rpm.

3. Start with the motorized control valve full open, record each of flow rate, electrical power, suction pressure and delivery pressure.
4. Repeat step 3 at different valve opens.

4-2 **Measured values**

Measured values will record in table (1)

Valve open %	Flow L/min	Suction pressure bar	Delivery pressure bar	Electric Power w
100	855	- 0.3	1.3	4020
95	842	- 0.3	1.3	4033
85	817	- 0.3	1.4	3990
75	732	- O .2	1.6	3850
65	562	- 0 .1	1.9	3470
45	343	- 0 .05	2.1	2750
25	123	0	2.2	2000
15	96	0	2.25	1857
0	0	0	2.3	1800

Table (1) Measured values

4.3 calculations

Calculations and are shown in table (2)

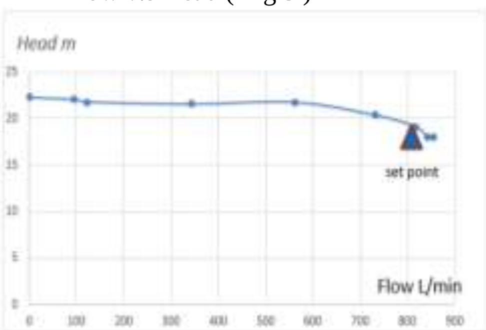
Flow L/min	Head m	Hydraulic Power w	Efficiency %
855	18.03	2516	62.6
842	18.1	2491	61.8
817	19.15	2558	64.1
732	20.4	2442	63.4
562	21.8	2003	57.7
343	21.6	1211	44
123	21.83	439	22
96	22.1	347	18.7
0	22.31	0	0

Table (2) Calculated values

VI. RESULTS

From previous calculation we get three relations:

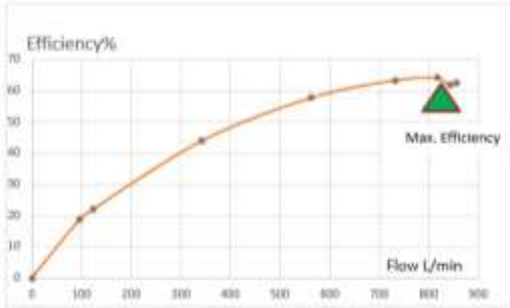
1- Flow v.s Head (Fig 3)



Flow v.s Head (Fig 3)

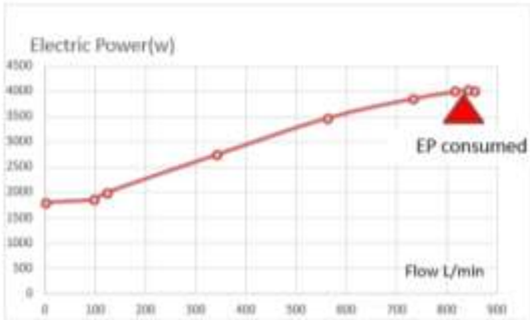
pump set point

2- Flow vs. efficiency (fig 4)



Flow v.sefficiency (Fig 4)

3- Flow vs. consumed power Fig (5)



Flow vs. electric power (Fig5)

VII. CONCLUSION

- The performance of pump is affected with running out of pump set point, pump should run at recommended back pressure and flow.
- From the graph Fig (4) the set point for the pump at 800 L/min and 18 m Total head that's lead to efficiency around 64 %
- Pump efficiency can increase if run at lower speed (2000 rpm) but it could not cover the flow and pressure demand.
- Three types of problems mostly encounter operation of caned pump: operate out of set point, poor maintenance practices and run out of recommended speed.
- The experiment results typical to pump charts of factory.

RECOMMENDATION

It's recommended to carry out a lot of medication to increase overall efficiency of pump using (CFD) in pump design, follow the pump operation procedure and apply preventative maintenance according to maintenance schedules.

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