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OPTIMISATION OF PUMP OPERATING REGIMES AND REDUCTION OF ENERGY CONSUMPTION

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SUMMARY

Possibilities of rationalisation of energy consumption in pumping systems are presented. Many pumping systems are using pumps with lower efficiency than maximum reachable. Operating regimes are not always optimal.

Reduction of energy consumption in the most of the optimazed pumping systems is between 20% and 40%.

Optimization of two pumping systems are analyzed. First one is irrigation system in Saudi Arabia where energy consumtion is reduced for 43 MW, and second one is reduction of energy consumption of high pressure pumps in mines in South Africa

Pumps are bigr consumers of energy and number of operating hours in the year is usally big. Energy expenses are big and due to the higher prices of energy this expenses are rasing.

Possibilities of reduction of energy consumption are big.

Important is proper choose of pump type and pump characteristics to be applied.

Following criteria are important

- Pump efficiency
- Pump type
- Type of Q-H and Q-NPSH characteristics
- Adaption of pump characteristics to the operating regime and tariff system

1. Analize of possibility of energy consumption

1.1. Efficiency

Efficiency is the most important criteria for choosing the pumps and minimize the energy consumption.
Pump efficiency depends of

- Specific speed nq
- Flow rate
- Type of pump

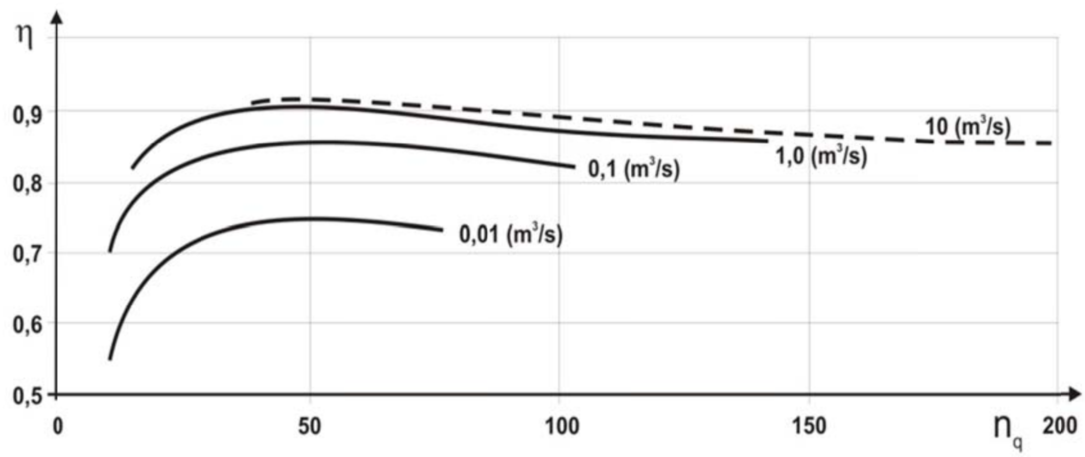


Fig. 1 Ratio between pump efficiency, specific speed and flow rate

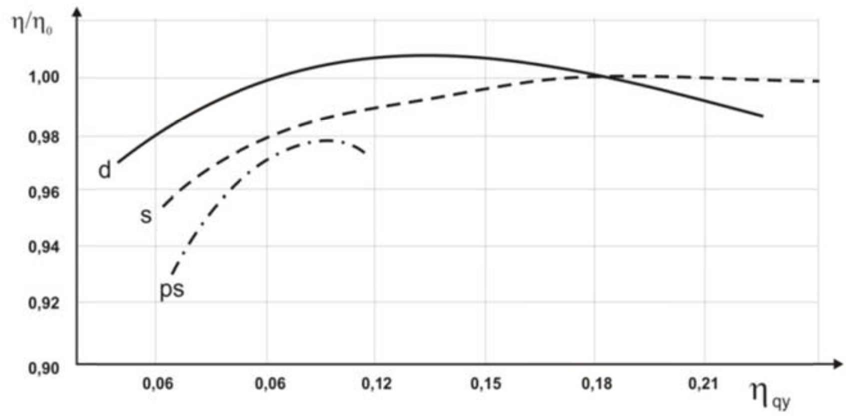


Fig. 2 Ratio between efficiency and pump types d – split casing, s – end suction, ps – multistages

- Pumps with very high efficiency on the market could be offered by limitted number of companies and not for all pump types
- Most of the manufacturers use tolerances for efficiency in catalogs according to DIN 1944/III or ISO 9906/II, and this means 5% lower efficiency and bigger energy consumption.
- Pump can reach maximum possible efficiency if special method of production is applied
- With pumps coming from srandard methods of producion it is not possible to reach good efficiency.

1.2. Optimal operating regimes

High efficiency is not enough to reach minumum energy consumtion. Pumps should operate in optimum range.

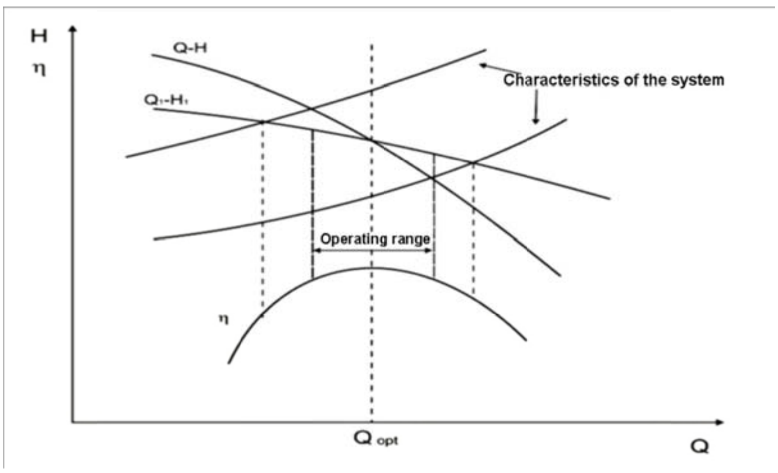


Fig. 3 Optimal operating range for different types of Q-H characteristics

- It is not good to choose the pumps according to the flow rate and head only.
- Pump characteristics should meet operating regime requirements
- Regulation of number of revolutions could adjust the characteristics to the requirements but it is necessary to have proper pump and not always this solution can save energy, in some cases effect is bigger specific energy consumtion.

2. <u>Examples of optimized pumping systems and reduction of energy consumption</u>

- Our analyzes showing that more than 80% of the pumps do not reach high efficiency and operate outside optimal regime.
- Usually reduction of energy consumption in pumping systems is between 20 up to 40%
- Rapid return of invested money 6 months up to 2 years
- Optimisation of the pumps and operating regimes is the cheapest way of getting more energy.

2.1. Optimisation of the pumps in irrigation system in Saudi Arabia

This project is realized in Saudi Arabia with company SMI which is manufacturer of pumps.

Existing irrigation system supply water for 40.000 hectars or 400 km2.

250 vertical pumps are installed in the well. Pumps are assembed 360 uo to 370 m under ground level.

Pumps are driven by 725 HP diesel engines.

Installed power 250 pump * 725 KS = **181.250 HP** or **<u>135,3 MW</u>**

Operating period is 8400 hours per year.

Fig. 4 Existing pumps Q = 340 m3/h, H = 330 m, P = 725 HP

Fig. 5 Fuel flow meter

Existing pumps have efficiency in optimum 64% and 57% in operating point.

Power consumption in operating point is 536 kW.

Hydaulic applied for new pumps has efficiency of 84% in optimum and characteristics of new pumps enable operation in optimum.

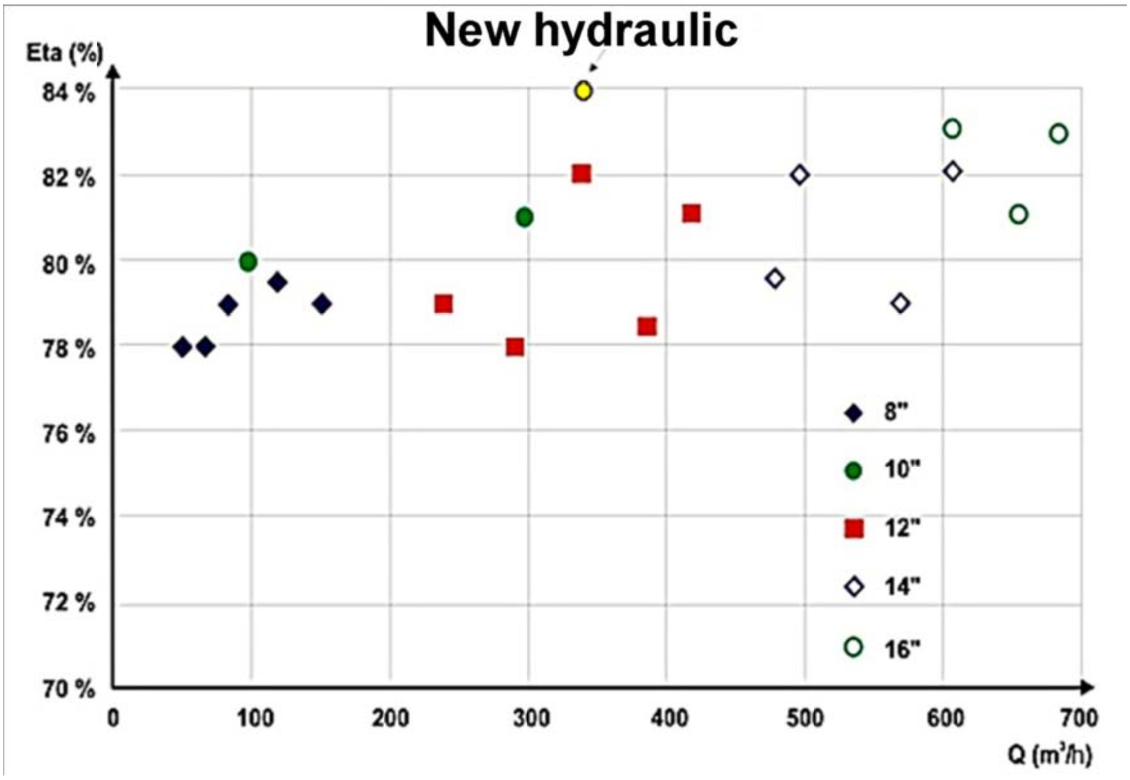


Fig. 6 Efficiecny comparison for different manufacturers

With using highest possible efficiecny it is possible to reach minimum energy consumptions.

	Q (m3/h)	H (m)	Eta (%)	P (kW)
Existing pump	340	330	57	536,06
New pump	340	330	84	363,75

Difference in energy consumption is **172,31 kW** for one pump.

Difference in energy consumption for 250 pumps is **43.000 kW** or **361.800.000 kWh/year**.

Difference in fuel consumption is

	Fuel consumption for one hour
Existing pump	107 l
New pump	77 l

Difference in fuel consumption for 250 pumps for one year is **63.000.000 litres.**

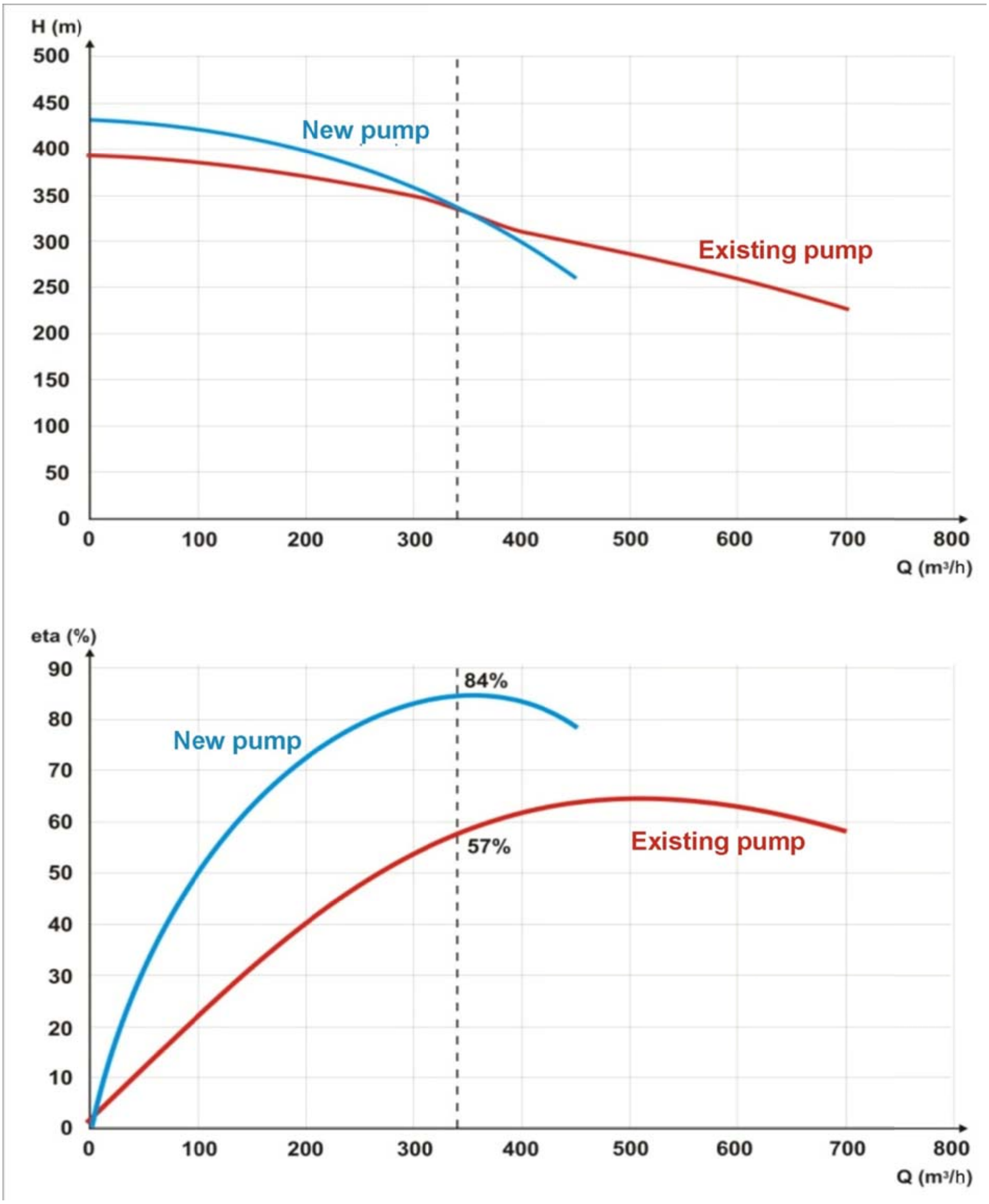


Fig. 7 Characteristic curves for new pumps and existing pumps

New pumps are produced with enamel coated diffusers which reduce the friction in the pumps and increase efficiecny.

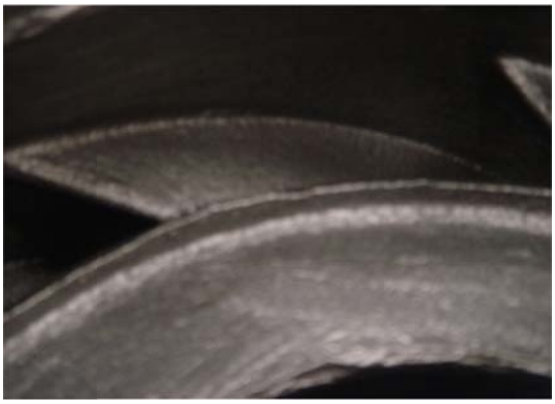


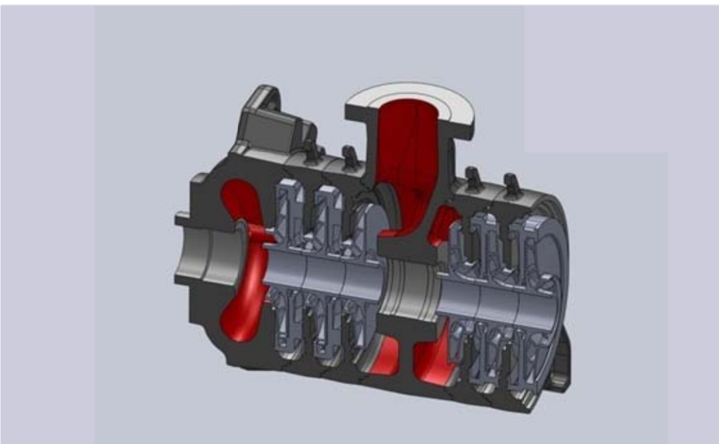
Fig. 8 Cast diffuser **Fig. 9 Enamel coated diffuser**

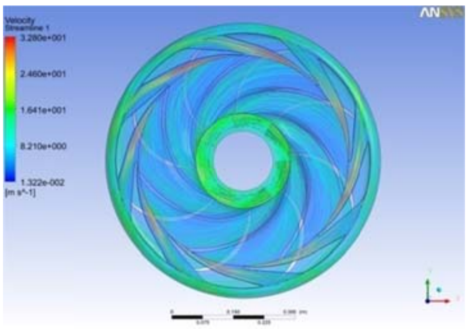
2.2. Optimisation of high pressure pumps for mines in South Africa

Existing pumps: Q = 520 m3/h, H = 1020, eta = 75,7%, P = 1.908 kW

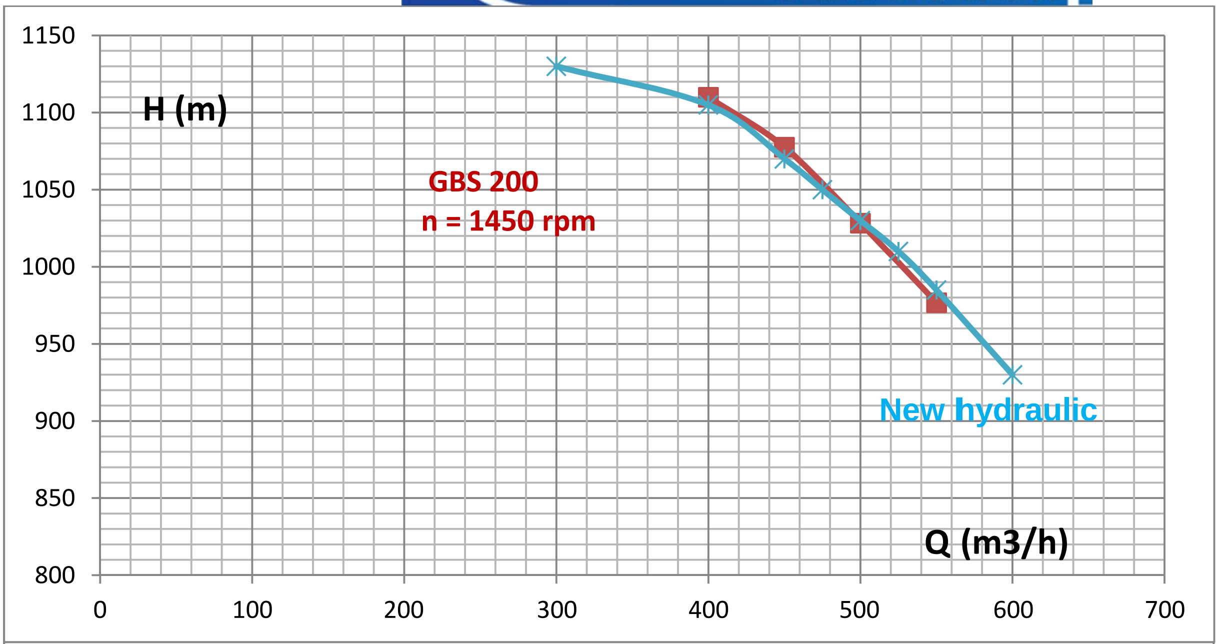
New pumps: Q = 520 m3/h, H = 1020 m, eta 79,2%, P = 1.823 kW

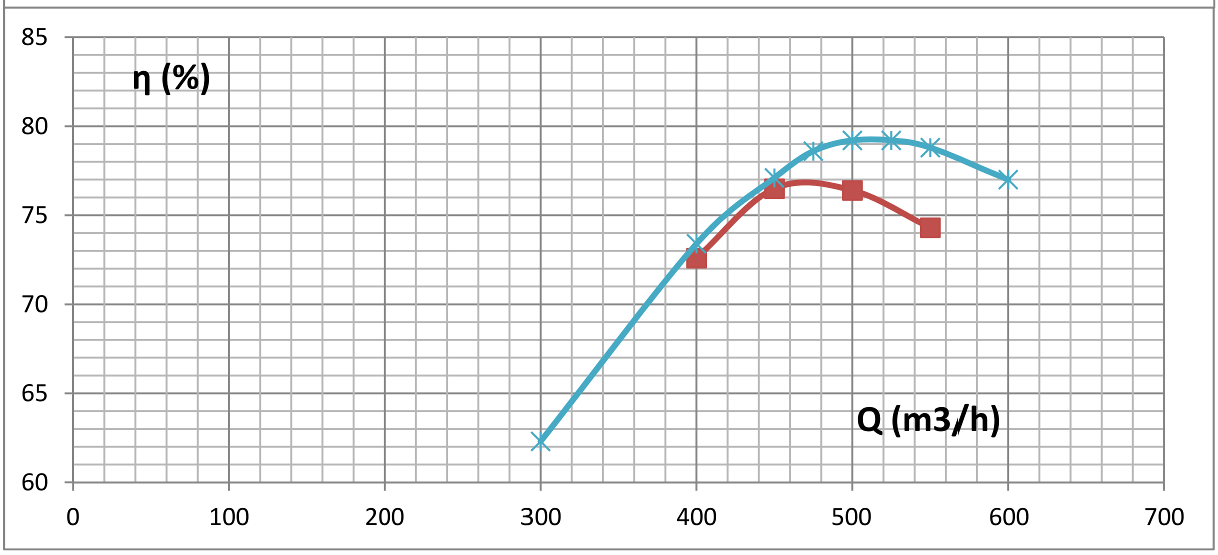
Energy consumption difference for one pump is 85 kW * 8000 h/year = 680.000 kWh/year





Optimisation is done with replacing the impellers and diffusers in existing pumps.





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