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ENERGETIC EFFICIENCY OF PUMPING STATION

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Abstract

The aim of this paper is to emphasize lower energy consumption in pump station that is equipped with variable speed pumps. This paper presents a comparison between different pump stations in terms specific energy consumption. We considered the following situations: adjusting the flow by valve and adjusting the flow by varying the speed. The study showed that pump station equipped with variable speed pumps are more efficient than the ones with fixed speed.

Key words: *pomps, energy consumption.*

INTRODUCTION

The fluid transport was a great challenge for human. Since old times people moved water wherever they needed; a great irrigation system was the Hanging Gardens of Babylon one of the 7th Wonders of the World, with great consumption of resources and energy.

MATERIALS AND METHODS

The data used in this study (flow and height) were from Bragadiru irrigation pump station and the used pumps where both with fixed and variable speed, Grundfos HS 200-150-381/367 3*400V, 60Hz, 5 equipments with 500m3 flow rate per equipment and 65m pumping height (Figure 1). The data analysis was performed by Grundfos WebCAPS Software (see Grundfos WebCaps http://net.grundfos.com/Appl/WebCAPS/custom?userid=GFRomania).

RESULTS AND DISCUSSIONS

First measurements were performed using equipment with fixed speed at flow rate 2500 m3/h, efficiency 83%, energy consumption 530 kW and 1780 rpm. The experiments showed that by reducing the flow rate from valve to a 2100 m3/h value, the efficiency, power and NPSH decreased and pumping height increased (Table 1, figures 2, 3, 4).

Table 1. Efficiency, power and NPSH values for different flow rates of fixed speed pumps

Q	H	P	η	NPSH
m^3/h	m	kW	%	m
2500	65,4	530	83,8	3,52
2400	66	518	83,1	3,39
2300	66,6	507	82,3	3.31
2200	67,1	493	81,3	3,25
2100	67,6	480	80,2	3,21

Figure 1. Grundfos HS Pumps

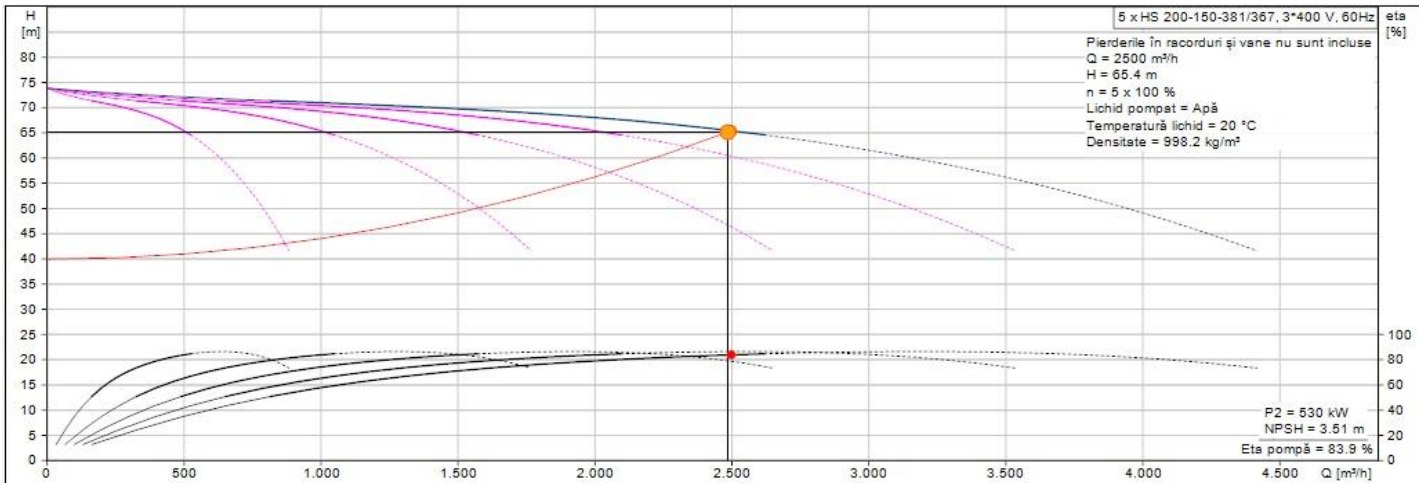

Figure 2. Operating point pumps whit fixed speed at 2500m^3

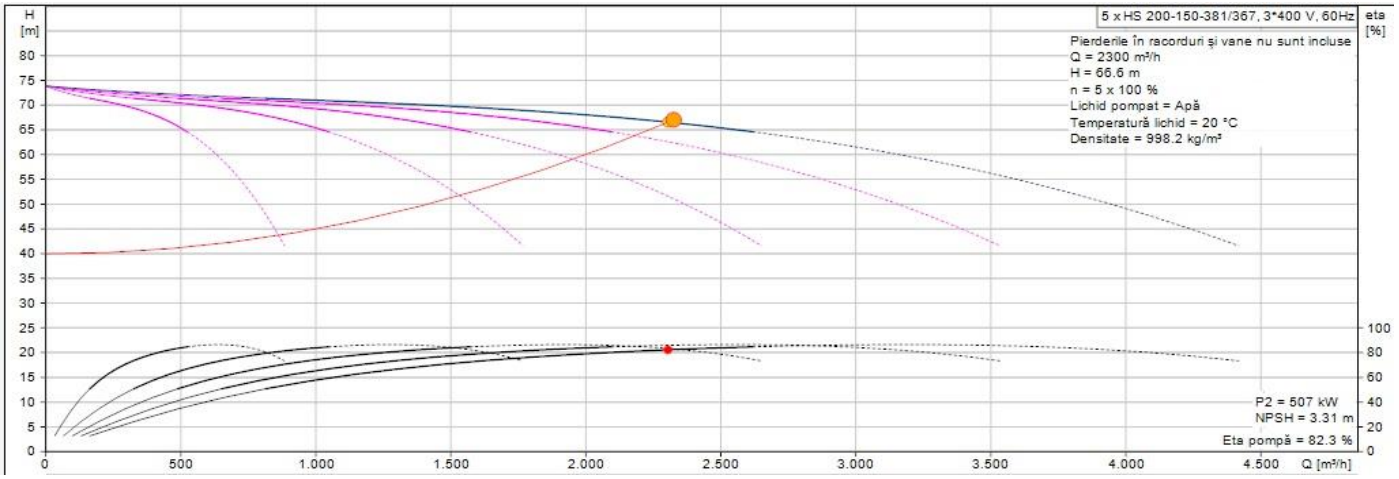

Figure 3. Operating point pumps whit fixed speed at 2300m^3

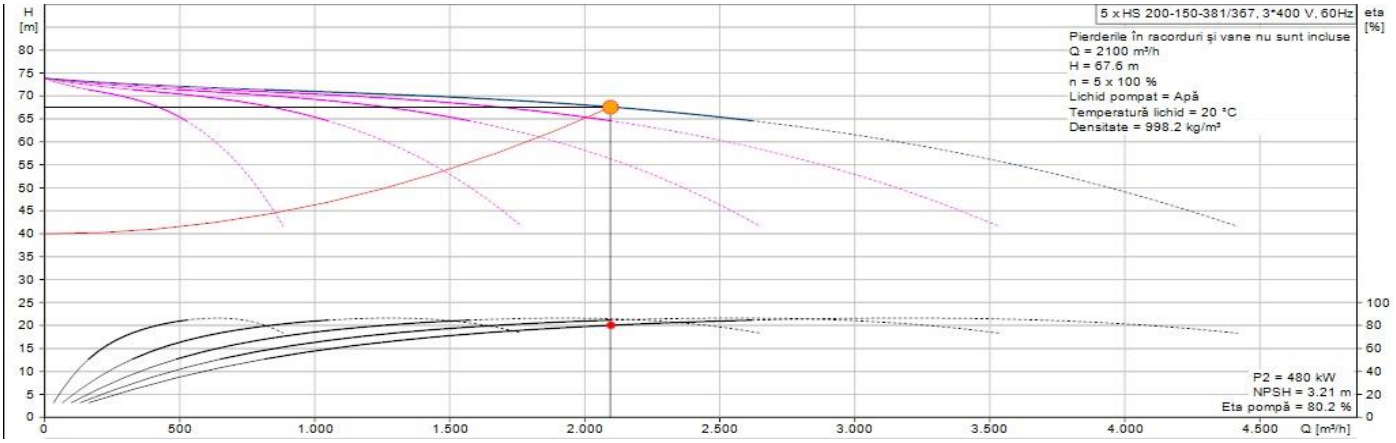

Figure 4. Operating point pumps whit fixed speed at 2100m^3

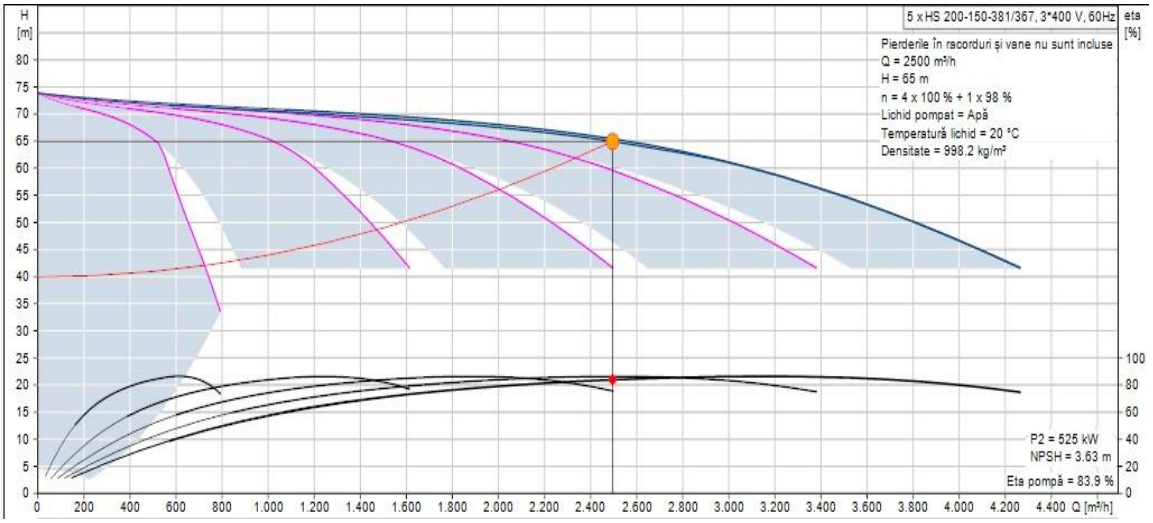

Figure 5. Operating point pumps whit mixed speed at 2500m^3

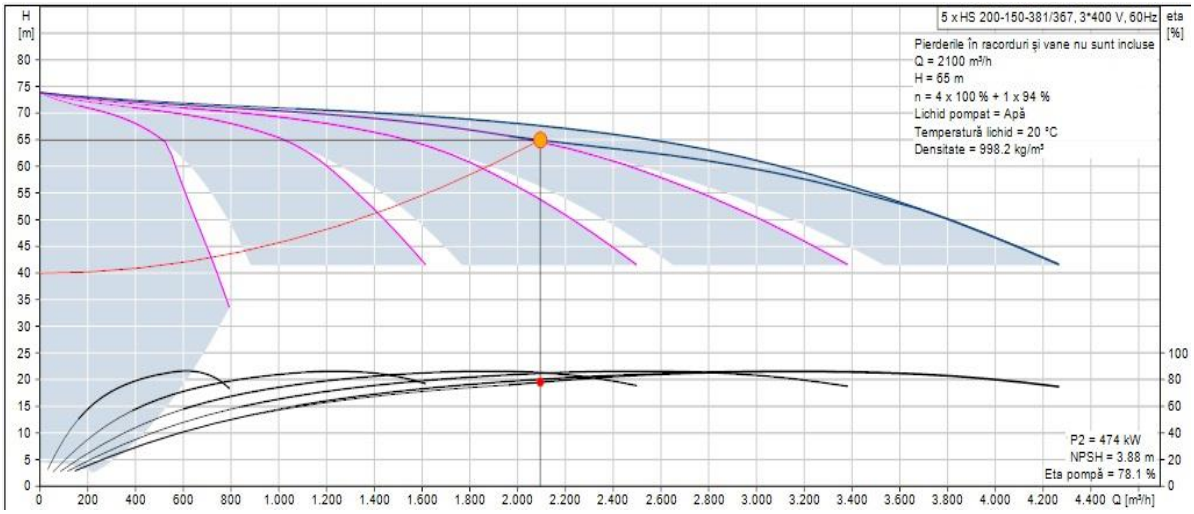

Figure 6. Operating point pumps whit mixed speed at 2300m^3

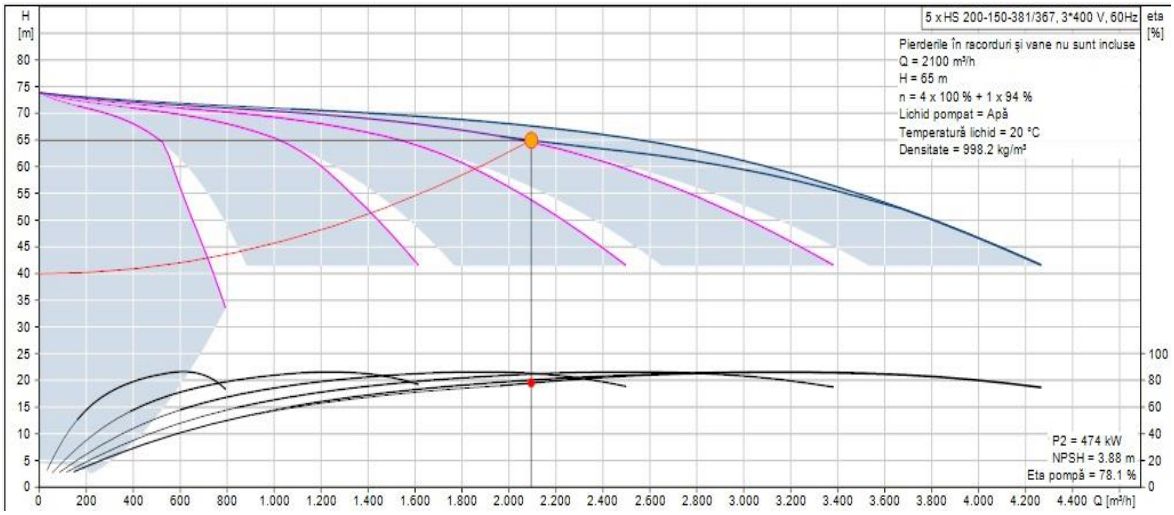

Figure 7.Operating point pumps whit mixed speed at 2100m^3

The next experiment used mixed pomp because the pomping height could not be kept at different flow rate without closing the valve.
If the pomping height is kept constant, there is no more stress and energy loss in the network (Burchiu et al., 2006). Table 2 and figures 5, 6, 7 show the operating point and energy consumption in mixed pump station.

Table 2. .Data about second pump station at different flow rate

Q	H	P	η	NPSH	N^{-1}
m^3/h	m	kW	%	m	%
2500	65	527	83.9	3.58	99
2400	65	511	83.1	3.58	97
2300	65	496	82	3.58	96
2200	65	482	80.4	3.66	95
2100	65	474	78.1	3.88	94

In the third experiment we used equipment with variable speed, keeping the flow rate and pumping height constant. The energy consumption is lower in this case, due to the variable speed pumps used.

Table 3.Data about third pump station at different flow rate

Q	H	P	η	NPSH	N^{-1}
m^3/h	m	kW	%	m	%
2500	65	529	83.9	3.58	100
2400	65	512	83.1	3.58	99
2300	65	491	82	3.58	99
2200	65	475	80.4	3.66	98
2100	65	459	78.1	3.88	98

The study presented in this paper showed that pump station equipped with speed variation pumps are more efficient (figure 8). For example, at 2100 m3 flow rate, the difference in energy consumption is 21 kW, which represents 4,4%. This value that appears to be small, is in fact significant for irrigations, and means a major energy saving.

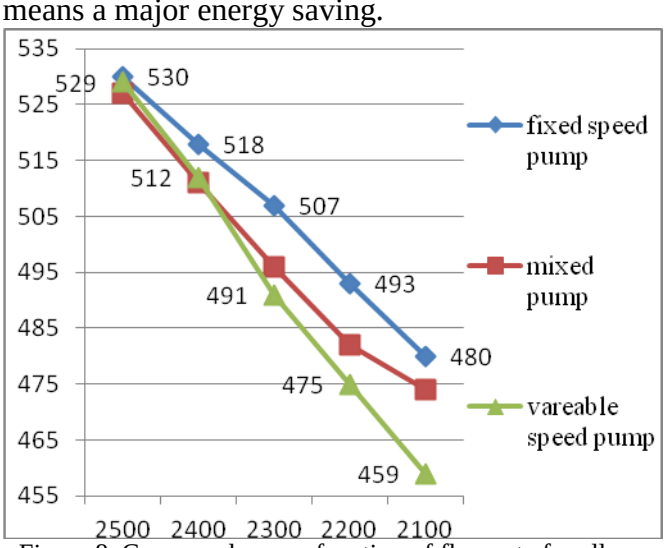

Figure 8. Consumed power function of flow rate for all three experiments considered

CONCLUSIONS

Avoid restarting because it takes 700% more energy to start up the pump.
Using 100% of pump capacity the lifetime of the pump is that guaranteed by producer. Using under 100% of pump capacity we can expend the pump lifetime.
Avoid using the pump in rush hours because the electricity is expensive.
The ratio kW / m3 between pumps is 0.21 for variable speed pumps and 0.22 for fixed speed pumps, which represents a major energy saving when speaking about great quantities.

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