Pump Audits for improving Energy Efficiency

The need for saving energy meanwhile has been realized everywhere. Economic necessity and political pressure by the EuP Directives have led to the verification of all industrial sectors for energy dissipation and to get it replaced by energy saving solutions. Since pumps are among the major industrial consumers of electricity, here the main activities are concentrated. Pump audits of existing pumping systems have successfully shown spectacular savings of up to 90 %. Thus the taken measures do pay for itself quickly. However also negative examples are known where ignorance did lead to misallocation and quite the contrary did occur. For example the simply installation of frequency converters without any analysis of the system conditions does not assure energy savings.

Product Approach versus System Approach

How the potential savings can be increased? European energy-saving projects pursue the product approach. Guided by the EuP Directives the energy efficiency of e.g. water pumps is being stipulated. In the medium term products with poor efficiency will disappear from the market. This is responsible but still not sufficient. Pumps always are part of a complete system. In case that only one component even on energy efficiency perspective is being optimized hardly an overall optimum can be realized. Theoretically at least it may even result in a deterioration.

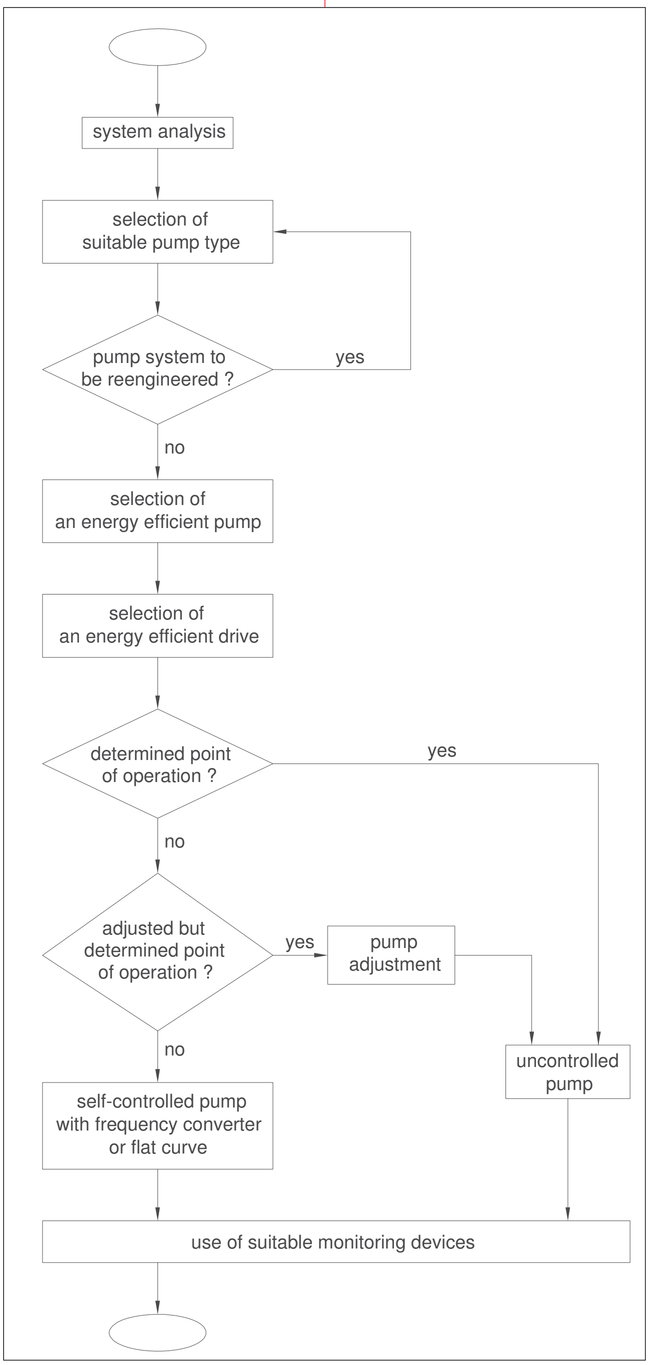

Fig. 1 System approach

For both the energetic auditing of existing systems as also the design of new systems the system approach has proved at Edur (Figure 1).

System Inspection

In many cases a pump audit leads to the conclusion that the pump does not work in its intended operating point but was selected oversized. The reason is human: in the primarily chain of selection manufacturer – designer – OEM – enduser each stage calculates with safety margins. However oversized pumps are wasting energy. The wrong selection may even lead to premature pump failure. Therefore safety margins should be eliminated and smaller pumps should be used instead, which however should include performance reserves for failures or peak demands.

The audit not only provides information about oversized pumps but also about the complete pump system. This includes the review of the piping system and all other system components. E.g. too small pipe diameters result in high velocity flows and unnecessary pressure losses. The same does apply to avoidable bends. Also the friction losses of filters, valves, measuring devices and other liquid-operated system components are to be mini-

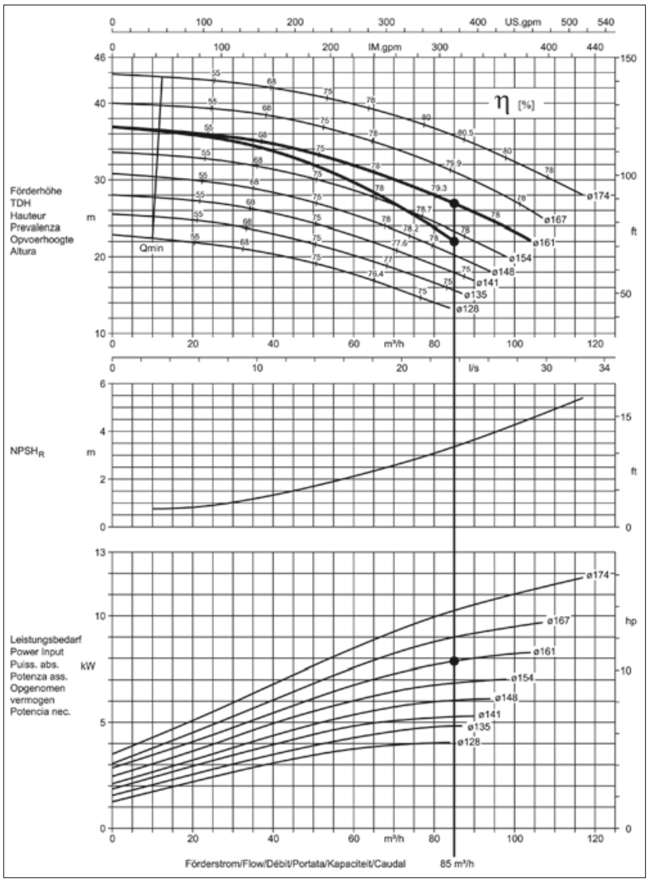

Fig. 2 A typical example of selection

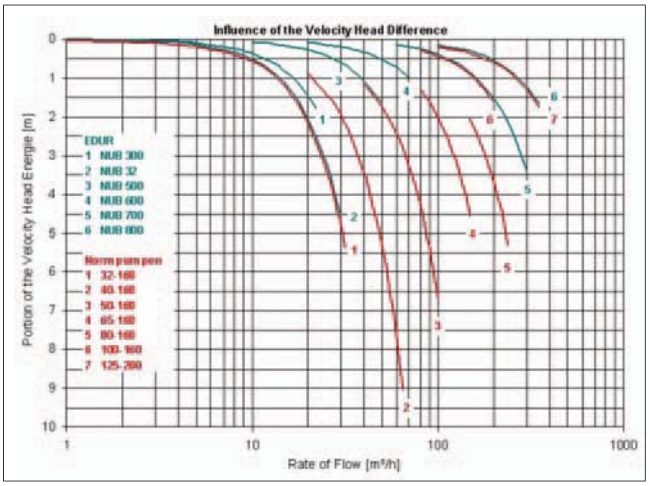

Fig. 4 Influence velocity head difference

mized. Also their necessity has to be questioned. In that the pump periphery does already show significant approaches for energy savings. In some cases also the complete system concept is being questioned. Thus acting as dynamic mixer multiphase pumps do substitute systems for gas enrichment.

Pitfalls during Pump Selection

So far everything was designed correctly and optimal from the energetic points of view. However, the system function is not given – may be that nozzles do not create sufficient pressure, the cooling capacity is not correct, the endusers are getting insufficient performance etc. One reason may be not having considered the velocity head difference. This means the pressure losses in the pump itself, which in accordance with DIN ISO 9906 do belong to the pump head, however (manometric heads) are not available for the system. These losses are especially high whenever the flow velocities in the discharge flange are getting too large.

Figure 2 contains a typical example of selection: the standard pump size 50–160 is selected for a flow of 85 m^3/h and a head of 27 m according to the pump characteristic curve. However due to the internal losses only an actual head of 22 m is being achieved. This is understandable for a velocity speed of 12 m/sec at the discharge flange. The pump itself here acts as an orifice plate. Such pump losses only can be avoided by pumps with sufficiently dimensioned nominal flange diameters. For this reason compared to the standard type sizes the Edur series NUB (Fig. 3) are designed with large nominal flange diameters and therefore low velocity flows and consequently negligible friction losses (Fig. 4). This of course also eliminates the otherwise necessary reduction or expansion pipe sections for the pump installation.

Efficiencies

The pump efficiencies are entirely conditioned by design features. The ultimate objective is to minimize the internal friction losses. Important features are a certain ratio between the impeller outlet and inlet diameter, minimizing the friction velocity between the impeller cover plates and casing walls, limitation of the impeller diameter and sufficiently sized

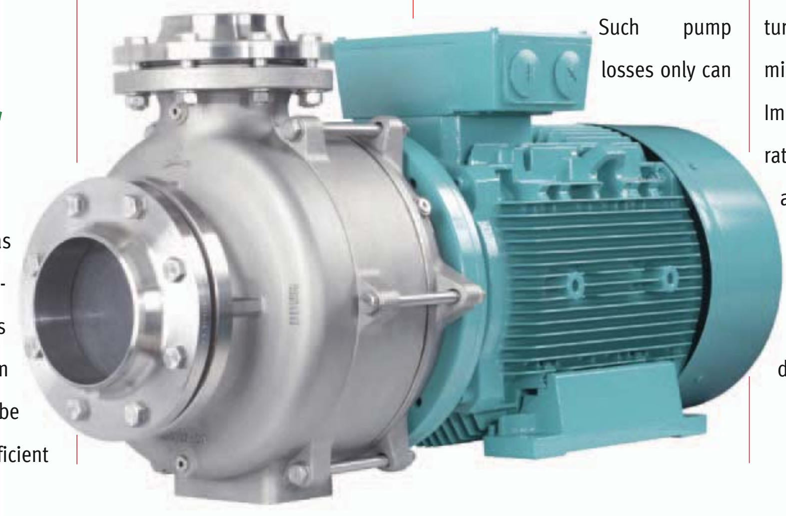

Fig. 3 The Edur series NUB

Saving energy is our most important source of energy

However quite seldom a pump audit ends with the use of high efficiency motors and frequency converters only. The most effective measures to improve the efficiencies of pump systems are not that spectacular and hardly cause any major investments. The decisive factor is a rethinking of those who purchase the pumps. Today no longer the lowest cost pump price but rather the decision in favour of the most energy efficient pump does make economic sense. This is valid even more as on average the purchase price of the pump amounts to 10 % of the total costs that are caused during the pump service life. At least for the endusers it is more and more recognized that the use of energy efficient pump systems finally does improve their own competitiveness.

nominal flange diameters. Unlike for spiral casing pumps Edur has implemented all of these design principles for their diffusor blade pumps and therefore does achieve very high efficiencies. Furthermore the open impellers do have a negligible axial thrust. The diffusor blades do also compensate the radial forces. Besides the energy efficiency a prolonged service life does result.

Especially in comparison to single-stage volute casing pumps with a large impeller diameter efficiency improvements of up to 30 % can be achieved when changing to multistage pumps instead. Also in other cases always the installed type of pump should be questioned instead of only comparing efficiencies of same pump type.

Energy savings by using high efficiency motors of efficiency class IE2 or premium efficiency class IE3 are rather modest due to efficiency improvements of 2 per cent in average compared to all other improvements.

Control Concepts for variable Points of Operation

In the past it was common to throttle a (oversize designed) pump to a new point of operation. Today such an approach is no longer accepted and energy is no longer wasted. One even the most expensive option is to adjust the pump curve to the corresponding system conditions by means of a speed-variable frequency converter. This ignores that VFDs themselves consume energy and in many cases more simple solutions such as cascade circuits, two-speed motors etc. are totally sufficient. A proven self-regulating pump also working without a frequency converter is the diffuser blade pump with a flat characteristic curve (Fig. 5). Here the pump does operate in a wide characteristic curve automatically changing the operating points, without the need for a separate control.

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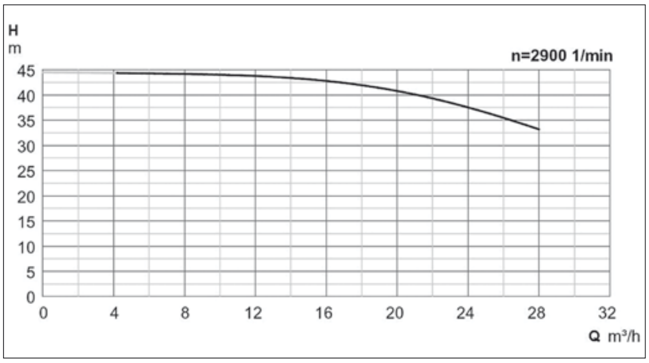

Fig. 5 Flat characteristic curve