ANALYSIS OF THE EFFECT OF A LAMELLA THICKENER ON IMPROVING THE OPERATIONAL EFFICIENCY OF CENTRIFUGAL PUMPS

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Centrifugal pumps are the most widely used pumps in industry. They are extensively applied in sectors such as chemical processing, oil and gas, mining, and power engineering due to their high efficiency, reliability, and ability to continuously transport various liquids, including water, chemical solutions, and petroleum products.

However, several key factors reduce the operational efficiency of centrifugal pumps. These include wear of the impeller and casing, mechanical friction losses, volumetric losses (leakage), hydraulic resistance, and liquid cavitation.

The efficient operation of pumps largely depends on the concentration of solid particles in the liquid, their dispersion characteristics, and hydraulic properties. When the liquid contains a high concentration of solid particles, its density increases ($\rho \uparrow$), hydraulic losses rise, abrasive wear of the impeller intensifies, and the pump efficiency (η) decreases.

Lamella thickeners have a positive effect on improving pump efficiency. Lamella thickeners are highly efficient devices designed for suspension separation, sludge thickening, and water clarification. They are widely used in the mining, metallurgical, and chemical industries. Due to the inclined arrangement of the plates, settled particles slide downward along the plate surfaces, accumulate in the thickening zone, and form a dense sediment layer. This sediment is subsequently discharged through a dedicated discharge mechanism, while the clarified liquid is removed from the upper part of the apparatus.

The concentration of solid particles in the clarified water is significantly reduced, reaching values as low as 50 mg/L. The reduction in solid content leads to a decrease in liquid density, a reduction in pump load, and consequently lower energy consumption.

Furthermore, the reduction in solid particle concentration in the clarified water decreases the abrasive wear of the impeller and pump casing. This increases the service life of the pump and extends the intervals between

maintenance operations. As a result, the technical availability factor of the pumping system improves.

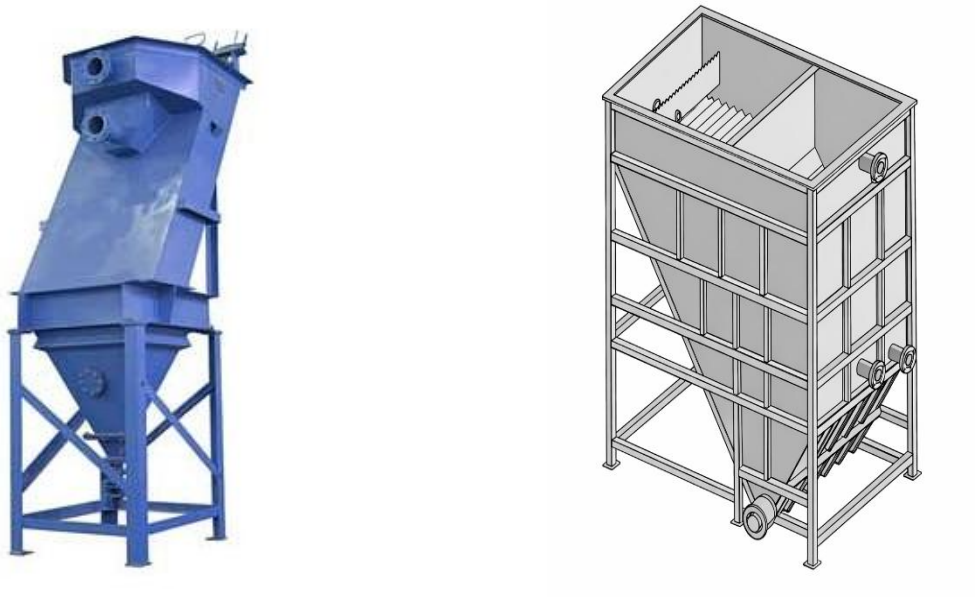

Figure 1. Lamella thickener

A sharp decrease in pressure at the pump inlet leads to liquid boiling and the formation of vapor bubbles. This phenomenon not only reduces pump efficiency but also causes metal erosion. Liquid clarified using a lamella thickener produces a more uniform flow and reduces pressure fluctuations at the inlet. As a result, the likelihood of cavitation is significantly reduced.

The decrease in hydraulic efficiency is caused by flow deviation within the impeller channels, changes in velocity, and friction losses. This is closely related to the viscosity and heterogeneity of the liquid. The use of a lamella thickener reduces flow pulsations, prevents the recirculation of solid particles, and ensures stable pump operation. Stable operating conditions allow the pump to function closer to the optimal point on its performance characteristic curve.

When a lamella thickener is applied:

- the required pump power can be reduced;
- the number of operating pumps can be decreased;
- maintenance and spare parts costs are reduced;
- energy consumption is lowered;
- overall operating and maintenance costs are minimized.

Conclusion

Lamella thickener–clarifiers have a significant positive impact on the operational efficiency of centrifugal pumps. They reduce the concentration of the solid phase, decrease energy consumption, increase pump efficiency, minimize abrasive wear, and ensure overall hydraulic stability of the system. As a result, the

reliability and economic efficiency of pump units improve, and the overall performance of the technological system is enhanced.

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