Multiphase Pumps

for Energy-Efficient Water & Wastewater Treatment

EDUR®

Multiphase Pumps for Energy-Efficient Water Treatment and Wastewater Treatment

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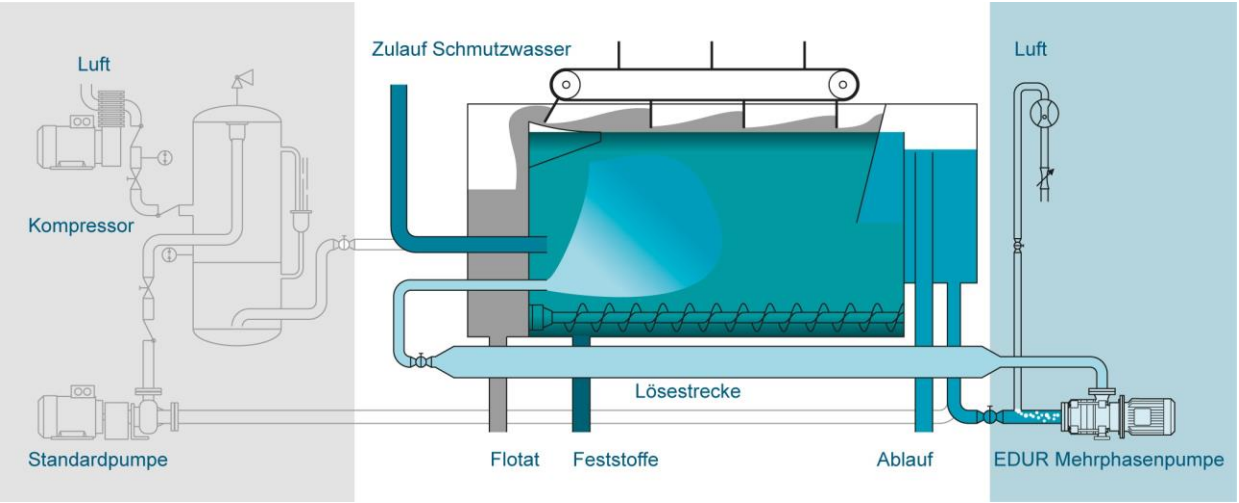
The EDUR multiphase pumps are unique products with outstanding features compared to conventional centrifugal pumps. The approach consists of using the pumps not only for transport of liquids but also for partial gas supply and as dynamic mixer for gas enrichment. Therefore, this novel pump conception barely has nothing in common with a standard pump. Even the mode of operation does no longer comply with the common doctrine: the multiphase pumps are slightly throttled at the inlet side, in order to get automatically sucked in gas contents. With standard centrifugal pumps this inevitably would result in cavitation.



Multiphase pumps are suitable for many processes. Gassing liquids that also need to be handled by pumps occur in many applications. A large market segment is the water and waste water treatment by means of dissolved air flotation (DAF) where the multiphase pumps provide the task of air saturation without the use of compressed air.

Multiphase pumps are dynamic mixers performing two functions. On the one hand liquids are being enriched with gases, on the other hand these liquid-gas mixtures are being transported. At the same time during the pressure generation in the pump a blending and an excellent gas saturation occurs. By means of following retention lines this gas saturation can be further enhanced.

The multiphase pump only is required for the gas enrichment. Static mixers are omitted. The gas is supplied directly into the suction pipe lines or into the inlet flange of the pump. The pump hydraulics itself then brings the gas contents into solution

Some typical applications are:

- Dissolved air flotation with a pressure saturation system corresponding to VDMA Specification 24430 Edition March 2010
- Aeration (Bioreactors)
- Ozonization
- Oil-water separation
- Elimination of lime in the paper industry
- Mineral processing (like copper extraction)

The use of multiphase pumps provides a lot of advantages:

- The reduction of the system components and the simplification of the system design results in lower investment costs and higher operational reliability.
- The high efficiency improves the energy balance and reduces operating costs.
- High degrees of solution in terms of the utilised gases improve the yield of recyclable fractions.
- Good control characteristics and a wide range of application of the multiphase pumps lead to an operation that meets the requirements and avoids uneconomical method of operation.
- Process reliability is significantly increased.

Consequently, the new pump conception amortises within a short period of time means that it is not only of interest for new plants but also for the retrofitting of existing plants.

Operating limits of centrifugal pumps

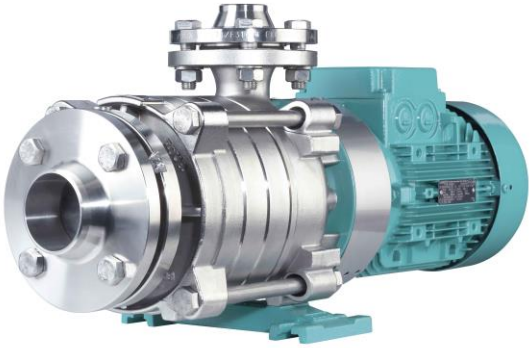
The usual purpose of centrifugal pumps is the transport of clean liquids. Unfortunately, this ideal typical utilisation is rare under real operating conditions. It is frequently the case that the pumps also need to handle undissolved gases or vapours.

Typically, liquids need to be enriched with gases, liquid-gas mixtures are to be transported or gassing liquids are to be handled safely. Under such requirements the well-known non-selfpriming centrifugal pumps either fail or do not enable safe operation. The process automation in particular requires a controlled and trouble-free pump operation.

Gas contents influence

The pump hydraulics of a modern multiphase pump is designed also for safe handling of gases. Furthermore, in case of separate supply of liquids and gases a good mixing of the two phases resp. a high degree of dispersion is achieved. The pump characteristic is essentially determined by the gas contents in the pumped liquid. The gas contents influence the flow rate, the pressure and the required pump power input. Increasing gas contents tend to decreasing flow rates and pump pressures but also to decreasing pump power input.

Operation as a dynamic mixer
By doing so multiphase pumps provide the gas enrichment of liquids. The gas is supplied into the suction pipe line or directly into the inlet flange of the pump



Multiphase pumps not only can be used for the transport of liquids, they can also be used for the transport of liquids with gases and gas enrichment.

Waste water treatment by means of dissolved air flotation
Dissolved air flotation (DAF) is a proven and well recognised procedure for the treatment of water and waste water and for the recovery of recyclables as well. It serves to simply separate substances that are suspended or emulsified in liquids. The special design of the multiphase pumps enables a direct gas input into the suction pipe line. As a result, system components like compressors, pressure tank, pumps, control devices and valves are not necessary compared to conventional systems.

Typical fields of application include the treatment of oil/water emulsions, fat separation, phosphate precipitation and heavy metal precipitations as well as secondary clarifications in biological purification plants. Multistage flotation systems are also well-known for the treatment of special waste. Many plant manufacturers report that by the use of multiphase pumps savings are not only made with regard to investment volumes but also for the continuous operating costs that on average amount to between 30% and 40% compared to conventional systems depending on the plant type.

New construction and retrofitting of existing plants
Slaughter house waste water
In addition to improved effluent values and a reduced utilisation of chemicals, users report of significant energy savings following the retrofitting of existing plants. For example, by replacing two side-channel pumps by an optimized multiphase pump energy costs of the flotation plant installed in an abattoir have significantly been reduced. The installed motor power was reduced by more than 50%. Here the customer complained about an insufficient flotation effect (formation of bubbles) and an insufficient pump service life of two months only.

Due to the improved formation of bubbles the effluent results have dramatically been improved. Furthermore, the flotate is significantly more compact. Additionally, less flocculants are required. The pump service life instead of formerly 2 months now is prolonged to actually more than three years. The energy balance has also significantly improved. For 220 working days and a 16 hour operating period per day, this equates to savings of more than 3.500 € per year (at 0,10 € / kWh) on energy costs only. Consequently, the retrofitting did amortise after only six weeks.

Municipal waste water treatment

Waste water from the city of Kiel and the connected surrounding communities has been pumped through long sewage outfall channels to the Bülk waste water treatment plant where it is treated and finally pumped into the Baltic Sea since 1929. Each year approximately 20 million cubic meters of untreated waste water is pumped to the waste water treatment plant which corresponds to a connected value of approx. 310.000 inhabitants and 65.000 inhabitant equivalents (industrial and commercial).
The existing dispersion pumps, pressure tank and compressors were replaced during a retrofitting in 2011/2012 by three of the successful multiphase pumps, each with 5 kW of motor power whereby one of the three pumps serves as a standby pump.
By operating in three shift system during assumed 220 working days, the energy savings only amount to more than 100.000 € (at 0,10 € / kWh) annually.

Many municipal waste water treatment systems worldwide have been retrofitting to the new multiphase system. All users report of similar savings.

Result

Supreme process reliability, energy efficiency, the simplification of the plant concept and the associated reduction of plant components that are susceptible to problems and are maintenance-intensive result in a wide acceptance of the innovative multiphase concept. Both the immense savings and the significantly lower running costs compared to the previous plant structure lead to extremely short amortisation times. Even the retrofitting of existing plants paid for itself after a short period of time.

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