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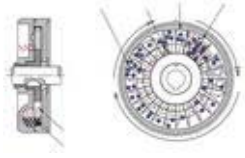
Side channel pumps in the production of biodiesel

Safe refining

Fig. 1: Design of a refining process
Fig. 2: Sero side channel pump with magnetic drive for very low NPSH values
Fig. 3: Delivery of gas content – principle of displacement
Pressure aperture
Gas exit
Interrupt
Suctian aperture
Push out gas / Side channel compressor
Suction
Gasring
Liquidring
Pessure in crease / Gas separation



From the initial unloading of rape seed oil up to the end product (biodiesel), side channel pumps offer many advantages due to their typical characteristics such as self-priming, an ability to handle liquids with a gas content of up to 50 % and very good NPSH values. Their use increases process safety throughout the various refining steps.

For more than a decade now, there has been an increasing demand for alternatives in the fuel market. Biodiesel is steadily growing in significance alongside natural gas and LPG. It is meanwhile established as a substitute for conventional diesel, meeting environmental requirements and attractively priced. In Northern Europe rape seed is mainly used to produce biodiesel. In North America soy beans are processed, while in the Far East palm oil is preferred. The initial oil resulting from the pressing process is unsuitable because it still contains numerous elements such as water and sediment that have to be extracted from the crude product. Before the pure rape seed oil can be used as a basis for biodiesel production, it has to be clarified by refining.

Refining process

Figure 1 is a simplified diagram of the refining process that shows the points at which Sero side channel pumps are used. The crude oil is first of all unloaded with the help of the first pump. A second pump is employed to transfer the oil from the tank to the neutralisation step. Following neutralisation, the oil is heated to approximately 90 °C. The water is then evaporated under vacuum in the dryer. Next, the oil is heated to approximately 130 °C and separated from the sediment and solids in the reactor by adding aluminium silicate as catalyst. The steeping tank ensures the necessary reaction time. The remaining

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suspended particles are subsequently filtered out. The pressure is increased with the help of a side channel pump and heat added up to 170 °C for the ensuing process steps. A residual degassing process takes place under vacuum and in the last step the remaining undesirable elements are separated by adding vapour to the steam supplier at 230 °C. The purified rape seed oil is cooled down by a heat exchanger and the waste heat used for other processes.

The refined rape seed oil is suited as edible oil or, when mixed with additives, as motor fuel. It also serves as a primary product in oil processing chemistry or for the production of biodiesel. In the latter case, the rape seed oil is treated in an esterisation process by adding catalysts and ethyl or methyl alcohol, which can likewise be produced biologically. The raw product still has to be clarified and separated from the catalysts. In the downstream distillation step, the alcohol residues are extracted while in the conditioning step, essential characteristics such as low temperature stability are achieved by introducing additives. Glycerine is obtained as a by-product. The biodiesel is now ready to be used as motor fuel.

Advantages of side channel pumps

The advantages of side channel pumps are of great importance for an increasing number of applications. The water contained in the oil is degassed easily at low pressures and high temperatures. Side channel pumps (Figure 2) represent an ideal solution for the processes involved in the refining of rape seed oil, namely neutralisation, degassing and clarifying. The ability to deliver liquid-gas mixtures with a gas content of up to 50% makes it possible to transport the oil within these processes without interrupting the flow. When the tank trucks are loaded or unloaded, the self-priming capability of side channel pumps permits the suction piping to be evacuated without manual intervention. The side channel pump is capable of self priming providing it contains liquid. The cross-section of the side channel widens at the inlet of the side channel stage (see Figure 3), is constant in the middle section and narrows again towards the discharge passage. A force is applied to the liquid in the outward direction owing to the rotation of the fan impeller and a liquid ring is formed. This ring remains in the side channel stage and together with the cross-section of the side channel forms the starting point for gas delivery; the gas is compressed in the direction of the exit aperture and the compression channel. As the mixture interacts with the impeller cells, it is compressed with a piston-style motion towards the inner area. When it reaches the exit aperture, the gas expands abruptly and a vacuum occurs in the impeller cells, causing the gas to be transported in direction of the suction aperture. During the gas separation phase, the side channel pump works like a displacement pump. After the side channel pump has finished priming, it works like a centrifugal pump. The liquid circulates spirally inside the impeller and enters and exits the side channel several times during one impeller rotation. The resulting pulse exchange is the reason why the head of a side channel pump is 5 to 10 times larger than that of a centrifugal pump with a radial impeller and the same diameter operating at the same speed. This phenomenon is also referred to as the inner multi-stage effect. Figure 3 shows the delivery of a liquid-gas mixture.

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