ENERGY EFFICIENT VACUUM FILTRATION CONCEPT

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The target of the project introduced here was to test and validate a new concept for forming and controlling vacuum level in industrial vacuum filtration applications by applying an innovative energy-efficient procedure. The main focus of the new concept is on vacuum filters used in chemical and mining industry where the CAPEX- and OPEX- costs originating from the production of vacuum currently play a significant role. Typically, the vacuum in these processes is created by using large liquid ring vacuum pumps which operate at constant rotational speed and the techniques used for controlling the vacuum level are fairly simple. The method that was created in this project relies partly on utilizing the potential energy of the filtrate and partly on advanced and high dynamic performance process control, which together enable significant savings in energy consumption in vacuum filtration processes.

The energy consumption of vacuum filtration operations typically depends on the properties of the feed suspension, the filtration conditions applied and the progress of the cake dewatering process. Operating a vacuum filter at high pressure difference requires a high air flow rate and thus results in high energy consumption. By taking into account the solids content of the filtered suspension together with the power demand and energy consumed at a certain pressure difference level, it is possible to investigate the specific power demand and energy consumption relative to the solids content of the filtered cake. When the mother liquor in the void space of the filter cake is replaced by air, the flow rate of air through the cake increases, which has a dramatic influence on the specific energy consumption. The results obtained in this project demonstrate clearly that both the air flow rate and the specific energy consumption during the dewatering increase sharply after a certain solid content of the cake is reached. The results suggest that the energy consumption as well as the pumping costs in vacuum filtration operations can be reduced substantially by allowing a slight increase in the residual moisture content of the filter cake. This also means that the vacuum filtration processes could be operated in a way that increases the energy and resource efficiency and eventually also reduces the carbon footprint related to these processes.