Allweiler Peristaltic Pumps: An ingenious solution for biogas plants

Installations and plants used to process biomass for the production of biofuels must be capable of handling difficult conditions. For example, intermediate products in the production of biodiesel exhibit a high level of chemical aggressiveness. Accordingly, pumps, pipe connections, and fittings must be capable of resisting these demanding conditions. In addition, waste products usually contain a large amount of impurities that can disturb the overall process. Depending on the origin of the material, this may include metal parts, sand, small stones, and crushed rock. Biogenic materials such as bones, sticks, or large pieces of wood add yet another challenge to the production of biofuels. In each of these situations, starting materials as well as intermediate products, residuals, and the final product must be pumped efficiently. Allweiler AG in Germany, a member of the Colfax Corporation, provides pumps that are ready to handle these situations. Allweiler's extensive experience, innovative technologies, and customer-oriented product development ensure that its customers have the appropriate solution for their applications, whether pumping biofuels or organic waste.

Allweiler pumps are proven

Allweiler progressing cavity pumps and peristaltic pumps have proven to be highly efficient for handling materials of various consistencies as well as materials that have been reduced or processed in a variety of ways. Progressing cavity pumps made of specially selected materials are the right choice for handling homogenous materials containing relatively small solids, whereas peristaltic pumps are ideal for materials containing larger impurities. Factory technicians regularly consult on-site with plant operators during start-up and even after installation. Their main objective is to optimize the systems in terms of maintenance and operating costs; in other words, they strive to minimize total cost of ownership (TCO).

Processing household and restaurant waste

Bioenergie Bamberg GmbH & Co.KG near Nuremberg, Germany provides a good example. A peristaltic pump plays a central role in its biogas plant. Since September 2005, the plant has produced electricity and heat from organic material. Feedstock includes organic waste from households, restaurants, silage corn, and gardens. The plant processes an average of 50 metric tons of biomass per day. Although the material is pre-cleaned and large extraneous materials are removed, it still contains about 15% crushed rock and sand with a grain size of up to 40 mm. Pieces of wood, fir cones, bones, and other solids like knives and forks up to 4 x 15 cm in size are also present. Such a varied composition places high demands on the pump.

In the first step of the process, a feed screw moves the feedstock into the fermenter. There a paddle stirrer homogenizes the biomass. After draining, cooling, and filtering, the resulting gas powers two 330 kW motors that feed approximately 15,000 kWh of electricity into the public network every day. A neighboring gardening center uses the generated heat (approximately 800 kW per hour) to heat its greenhouses.

Approximately 80% of the original material remains in the fermenter in the form of digestate containing about 25% to 30% dry material. The Allweiler peristaltic pump moves this substrate into a separator. The material is later used as agricultural fertilizer. The pump runs eight to ten hours per day depending on the fill level of the fermenter. With the exception of maintenance, the plant itself operates 24 hours per day, 365 days per year.

High solids contamination

The physical characteristics of the liquid are the main challenge for the pump, with properties similar to that of pudding and a large amount of solids. Temperature is approximately 55 °C. Because of these properties, the gravel contained in the liquid initially settled in the suction line between the fermenter and the pump. The impact of these solids was revealed when the company installed a rock trap between the fermenter and the pump. They removed it a short time later because it had to be emptied every other day. The suction line was originally 25 m long and horizontal, which further encouraged sedimentation. To loosen the sediment, the peristaltic pump had to repeatedly build very high suction pressure of up to one bar for short periods of time so the chunks of sediment could be moved. This has placed extremely high loads on the pumps.

Allweiler helps

Working together with the manufacturer of the peristaltic pump, the company optimized the system in several steps, thereby increasing the service life of the pump hoses and improving overall efficiency. Changes included drastically shortening the suction line to only 4 m, moving the suction line to the upper flange, and moving the pressure line to the lower flange of the pump. This reduced the amount of sediment in the line, while also reducing the amount of sediment in the pump during times when it is not pumping. Pressure measurement devices in the piping and a fill-level indicator protect the pump both from dry running and excessive pressure spikes. If the controller detects blockage in the line, it automatically switches the pump’s direction of rotation so the line can be cleared. The optimization greatly reduced the switch-over time in response to dry running, when the pump tries in vain to move liquid from the clogged suction line. The pump now changes direction of rotation after about 20 seconds, greatly extending the service life of the hose. By implementing these and other optimizations in the feed and pressure lines, the company gathered a great deal of valuable experience. In fact, they plan to use the same model pump when they expand the plant. Despite the difficult conditions caused by large and

abrasive solids and relatively long idle times, the hoses can stay in service for more than one year and more than 3000 operating hours. Heavy wear caused by abrasion no longer results in premature hose failure. The hose material selected by the manufacture has proven to be extremely durable. “Early” hose replacements are usually necessary only if sharp-edged solids cut into the hose.

Efficient solution

According to Jörg Stadter, responsible for plant operations, "Our experience has shown that no pump or pump type is better suited for this application. The manufacturer’s step-by-step optimization played a major role. As a result of their efforts, the hoses can stay in service for much longer than before." A test of a rotary lobe pump confirmed this sentiment. After just a few days the pump failed with irreparable damages. Concrete pumps have an adequate design and service life, but have much higher procurement and operating costs, according to the plant operator.

Requirements

Pump biomass with a high proportion of abrasive impurities and large solids during production of biogas.

Solution

Application of a large Allweiler peristaltic pump and step-by-step optimization of the entire system by Allweiler technicians.

Result

Long hose service life of more than one year, more than 3,000 operating hours, low maintenance, and low overall pump costs.

About the author:

Jörg Gertz has been employed at Allweiler AG for nine years. Since 2005 he is Director of Sales at Allweiler's Bottrop location.

ABOUT ALLWEILER:

Founded in 1860, Allweiler AG is the oldest German pump manufacturer and market and technology leader in the areas of ship-building, power generation and special industrial applications. Its product portfolio includes centrifugal pumps, propeller pumps, screw pumps, progressing cavity pumps, hose pumps and macerators as well as complete pump systems. Allweiler AG owns a foundry and manufactures its own stators. The company also produces ready-to-use fuel skids, lube-oil skids, and rinsing-water facilities. Allweiler AG has its main German headquarters in Radolfzell on Lake Constance as well as a major production site in Bottrop, Germany. Allweiler AG has been part of the Colfax Corporation since 1998.

ABOUT COLFAX CORPORATION

Colfax Corporation is a global leader in critical fluid-handling products and technologies. Through its global operating subsidiaries, Colfax manufactures positive displacement industrial pumps and valves used in oil & gas, power generation, commercial marine, defense and general industrial markets. Colfax's operating subsidiaries supply products under the well-known brands Allweiler, Fairmount Automation, Houttuin, Imo, LSC, Portland Valve, Tushaco, Warren and Zenith. Colfax is traded on the NYSE under the ticker "CFX." Additional information about Colfax is available at www.colfaxcorp.com.

An example of typical solids that the peristaltic pump must move.

Jörg Stadter and a colleague keep the plant running around the clock.

The “ASH 1000” peristaltic pump from Allweiler is designed to move 200 l per minute at a speed of 10 rpm. These seal less pumps achieve maximum discharge pressure of 16 bar, maximum suction under pressure of 0.95 bar, and a maximum flow rate of 1000 l per minute. They are capable of moving liquids with a viscosity up to 100,000 mm^2/s.

The digestate even contains bones that must move through the pump's hose.

The most recent optimization (modified piping diameter) took place in the summer of 2006. Together with pressure and fill-level monitoring, hoses can now stay in service for up to 12 months.

The digestate is used as agricultural fertilizer.