Vacuum Conveying Reduces Operating Costs

Conveying Technology. A manufacturer of plug-in connectors annually produces about 20,000 different small parts on more than 100 injection molding machines. A central vacuum conveying system with Mink claw vacuum pumps supplies material to the individual machines and transports the runner regrind back to a collection bin.

Fig. 1. Partial view of the central vacuum conveying system with Mink claw vacuum pumps at Phoenix Contact (photos: Busch)

A new building for plastic parts manufacturing was erected for Phoenix Contact GmbH & Co. KG, Blomberg, Germany, allowing consolidation and expansion of the previously decentralized production areas at the site. The manager of plastic parts manufacturing, Jens Fischer, developed a new manufacturing layout, and it was clear already at the planning stage that the dry-sealed Mink vacuum technology would be employed for vacuum generation in the pneumatic vacuum conveying system. The first positive results of working with a Mink from Dr.-Ing. K. Busch GmbH, Maulburg, Germany, were made in 2004, when the maintenance required was reduced to almost nothing compared to that for the previously employed conventional oil-lubricated vacuum pumps.

Simultaneously with the start of production in the new building, a new conveying system from Digicolor GmbH, Bielefeld, Germany, to supply material by means of a central vacuum system **(Fig. 1)** was placed in operation. It consists of a total of 28 Mink claw vacuum pumps in two different sizes, and supplies material from octabins and collecting bins through the dryers to the injection molding machines and return of runner regrind, which is generated directly at the machines, to the collecting bins. Phoenix Contact processes a wide variety of colors as well as compounds based on different materials. The vacuum conveying system reflects this complexity. It takes 85 dryers alone to remove residual moisture from the materials prior to injection molding.

Production is largely automatic in a three-shift operation. This means that all machines must be supplied with material reliably 24 hours a day. The individual vacuum pumps are in operation between 70 and 90 % of the time and thus accumulate from 5,000 to 7,000 operating hours annually. Maintenance is limited to changing the gearbox oil, which the manufacturer specifies be done every 20,000 operating hours. Under these conditions,

Energy cost comparison for vacuum generation	Central vacuum conveying with Mink claw vacuum pumps	Central vacuum conveying with oil-lubricated vacuum pumps
18 vacuum pumps at 140 m^3/h each 10 vacuum pumps at 250 m^3/h each	54 kW 45 kW	72 kW 55 kW
Total power consumption	99 kW	127 kW
Operating hours/year	5,000 h	
Cost of electricity	0.08 EUR/kWh	
Total cost of energy/year	99 kW x 0.08 EUR x 5,000 h = 39,600 EUR/a	127 kW x 0.08 EUR x 5,000 h = 50,800 EUR/a
Energy savings from Mink claw vacuum pumps	**11,200 EUR/a**	

Table 1. Comparison of energy costs for conventional oil-lubricated vacuum pumps and Mink claw vacuum pumps in a central vacuum conveying system

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this translates into an interval of three to four years between changes. Manfred Nunne, the production supervisor, still remembers the amount of maintenance needed for the oil-lubricated vacuum pumps, where the oil, the oil filter and the internal filter inserts had to be changed annually. This entailed downtime, costs for the oil, its disposal and replacement of worn parts.

Operating Principle

Mink claw vacuum pumps compress the drawn-in air without the need for an operating fluid and without contact between the moving parts in the compression chamber. This results in no wear compared to other mechanical vacuum pumps. This is made possible by the Mink claw technology, where two precisely manufactured claw-shaped pistons rotate next to one another without touching either the other or the housing. Air currents in the minimal gaps between the moving parts provide for sealing and in this way attainment of the low final pressure. On the basis of this design principle, it has been possible to design an almost maintenance-free vacuum pump with almost no parts subject to wear, minimizing all the costs and downtime associated with maintenance **(Fig. 2)**.

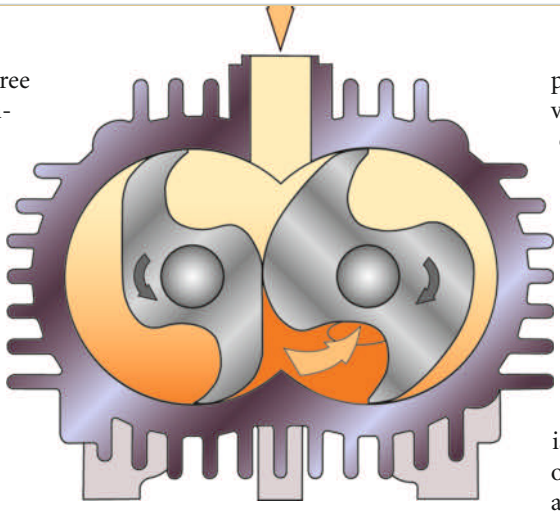

Fig. 2. Section through a Mink claw vacuum pump

Manfred Nunne can confirm the high availability of Mink claw vacuum pumps: since the first such vacuum generators were introduced in 2004 and with continuous procurement of additional pumps to today's total of 28 Mink claw vacuum pumps not a single failure has occurred despite the high number of operating hours.

The non-contact operating principle of the Mink claw technology offers an additional benefit: it achieves higher efficiency than other mechanical vacuum pumps. For the operator, this means that power consumption is considerably lower. A Mink claw vacuum pump can be operated with a motor that is at least one rating class lower than for other mechanical vacuum pumps yet achieve the same suction capacity **(Table 1)**. At Phoenix Contact, this can be seen clearly in the annual costs for energy: At least 11,000 EUR are saved annually in this regard. ■ **GG**

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