

Modula系统，Piovan公司生产的高效干燥设备

首次在欧洲发布的高效聚合物干燥系统的专利，自适应多料斗干燥系统新生产线，可提供最佳化的和始终如一的生产条件，且能耗较低。

Periphery: Modula, the High-Efficiency Drying Solution from Piovan
New line of auto-adaptive multiple hopper drying systems delivering optimal and consistent operating conditions and lower energy consumption. First patent issued in Europe for a high-efficiency polymer drying system.

吸潮的聚合物

对于不吸潮的聚合物，潮气只依附于表面，可采用通常方式进行干燥。而另一种情况下，对于吸潮的聚合物，潮气同样渗透到树脂内部，所以干燥系统需要采用铝硅酸盐来制备干燥空气，铝硅酸盐可以捕捉水分子。

最新的干燥系统能够不停地工作直至彻底地降低残留的潮气，并且它能够准确地将含潮量调节到聚合物加工所需要的水平。系统非常可靠，也就是说，运行具有稳定性和结果的可重复性，并且高效节能。

在开发Modula这种新型设备时，除了上述功能（高可靠性，高效节能）以外，Piovan已经将工艺控制元件进行了整合：

- 经过干燥后的聚合物，其物理特性有着一致性；
- 系统自动适应聚合物的初始状况条件，这样，工艺上的要求就得到了满足。

干燥过程面临着许多变化因素：

- 干燥温度；
- 空气露点（残留潮气的数量）；
- 气流的干燥能力和需要加工的塑料粒子的特性；
- 周围环境的温度；
- 物料的初始含潮量；
- 被加工的料的实时数量；
- 残留的潮气。

Piovan的Modula设备项目于2010年开始启动，所有上述参数都被加以考虑，现在所提供的系统已经迈上了新的台阶。

Modula是多料斗、中央控制的全自动干燥系统

它可以依据周围环境的温度、初始含潮量水平、聚合物的种类和数量、聚合物的最终含潮量、以及粒子的尺寸，自动适应并自动控制操作参数。在包含有若干不同种类的物料的应用情况下，中央单元通常用来产生干燥空气，并将空气分配到各个料斗，每个料斗对应于一种原料。为了实现最优化的运行，根据不同的工艺变化，每个料斗都需要特定的条件（空气流，温度和压力）。

安全的做法是：按部就班地接受这些条件，并且干燥系统的规格按照最大的物料消耗、最高温度、采用最大的空



气流量，用最接近临界值的工艺参数进行配置。但是，由于这些极端的条件很少出现，这样的配置不利于实现最佳能源效率的目标，并且抬高了运行成本。与此不同的是，Modula设备采用软件调节控制，总体上仅仅消耗按照需求被严格限定的能源量，针对每一个料斗优化工艺设定。设定的工艺参数不停地与安装在系统中的传感器所收集到的数据相比较。在每一个料斗的空气供气线路上都装了拥有专利的测量单元，可实时地独立调节和控制空气流。总的空气流量由中央干燥单元自动调整，这样，工艺运行条件实现了最佳化。采用这种方式，中等容量的Modula系统（干燥聚合物能力200-250kg/h）与相同干燥能力的传统中央干燥系统相比，节省能源可高达50%。

当前，如果要求中央干燥系统能够精确计算加工要用到的物料种类及每一种物料所用到的数量，并且相应地调节运行参数，那么Modula是唯一能够实现这些目标的设备。此外，除了能够保持恒定的露点，Modula还可以调节送到物料的空气流的流量，实现能源的有效利用，同时还调节了被加工的每一公斤聚合物的热负载。

Modula的控制系统采用了一种算法，通过输送到不同料斗的空气数量的变化，即所需要的循环空气的流量来保持热负载的恒定。当料斗内的全部热能都传输到物料中时，就实现了最高的设备运行效率。这样一来，从料斗回流到干燥机的空气不再需要冷却水，系统能够确保运行，且水分子会被硅酸铝分子筛所吸收。

2013年五月，Piovan的Modula设备在欧洲获得了高效聚合物干燥系统的首次专利。

Modula：配置和特性

新配置的特性是：干燥空气发生器单元可以连接到多达16个料斗。这一单元可以设定为并行操作方式，以保证百分之百的冗余，换句话说，提供绝对一致性的加工。在此情况下，两台发生器单元总是以部分负荷的方式工作，变频控制的能效等级为IE3的工艺风机能效实现了最大化。每个料斗都有一个独立的加热室以控制聚合物温度，以及一个Piovan设计的拥有专利的实时测量空气流动质量的测量系统，即使在出现紊流和在改变温度以及压力的情况下，系统也能正常工作。

Modula设备现在有三种不同的配置：SMART，PLUS和ADAPTIVE，可以满足不同的运行要求。Piovan精良的软

件通过微处理器对设备进行电子控制，操作者界面为8英寸彩色触摸屏。中央控制屏提供了可以通向所有系统部件的入口，同时每个料斗都配备了本地控制屏，可进行特定的调整或设定。

料斗进行了新型抗震动外表面处理，保持着独特的 Piovan 设计，也就是：一方面可保证操作者的安全，另一方面，不管内部的温度如何，外部表面温度从来不会超过 40°C，同时，干燥空气和物料之间实现了最充分的热交换。

The plastics industry processes non-hygroscopic and hygroscopic polymers

In non-hygroscopic polymers, the moisture is superficial and therefore eliminated by routine drying. With hygroscopic polymers, on the other hand, the moisture also penetrates into the resin, and so a drying system generating dry air using aluminium silicate, a material capable of trapping water molecules, is required.

Modern drying systems do not stop at drastically lowering residual moisture, instead they regulate the exact content to required levels for polymer processing. The systems are highly reliable – which means operating consistency and repeatable results – and energy efficient.

In developing the new Modula, Piovan has incorporated process control elements in addition to these bonus features (high operating reliability, energy efficiency):

- consistency in the physical characteristics of the polymer after drying;
- the system is adapted automatically to the initial conditions of the polymer and those required by the process.

There are many variables in the drying process:

- drying temperature;
- air dew-point (the quantity of residual moisture);
- the airflow capacity and the properties of the plastic granule to be processed;
- ambient temperature;
- initial moisture;
- instantaneous quantity of material processed;
- residual moisture.

All these parameters have been taken into account in the Modula project, launched by Piovan in 2010 and now offered in a new range of systems.

Modula is a multi-hopper, central, fully automatic drying system

It can adapt and automatically control operating parameters based on ambient temperature, initial moisture level, type and quantity of polymer, the final moisture content of the polymer, and granule size. In the case of applications that involve a number of materials of different kinds, a central unit is commonly used to generate dry air, which is then distributed to a series of hoppers, one for each material. Each hopper requires specific conditions for optimum operation (air flow, temperature and pressure) depending on the different process variables.

A safety condition is systematically adopted and the drying system is sized based on the most critical processing parameters, at maximum material consumption, at maximum temperature, with the highest airflow. However, this goes against any principle of energy efficiency and raises running costs, as these ex-

treme conditions rarely occur. Instead, Modula software adjusts and controls optimal operating settings for each hopper using only the overall amount of energy strictly required. The settings are constantly compared with the data collected by the sensors installed on the system. A patented measuring unit, located in the air supply line at each hopper, adjusts and control the air flow instantaneously and independently. The total airflow is modulated automatically by the central drying unit, resulting in optimum process operating conditions. This way, a medium capacity Modula system (drying 200-250 kg/h of polymer) provides savings of as much as 50% with respect to traditional central drying systems of equivalent capacity.

Today Modula is the only central drying system capable of calculating exactly how much material, for each type, is used by the presses and adjusts the operating parameters accordingly. In addition to maintaining a constant dew-point, Modula adjusts the airflow to the quantity of material effectively used, regulating the thermal load for each kg of polymer processed.

The control system of Modula is provided with an algorithm which varies the quantity of air supplied to each individual hopper, circulating the air content required to keep the thermal load constant. Maximum operating efficiency is achieved when the entire thermal energy in the hopper is transferred to the material. The air returning from the hopper to the dryer therefore does not require cooling water in order to ensure system operation and absorption by the aluminium silicate molecular sieves.

In May 2013, Piovan obtained for Modula the first patent issued in Europe for a high-efficiency polymer drying system.

Modula: configurations and features

The new configuration features an air generation unit that connects to up to 16 hoppers. The unit can be set up to operate in parallel to guarantee 100 per cent redundancy, in other words delivering absolute operating consistency. In this instance, the two generation units always work in partial load mode to maximise the energy efficiency of the inverter-controlled, IE3 class process blowers. Each hopper has an independent heating chamber to control the polymer temperature and a measuring system for the air flow designed and patented by Piovan that instantaneously measures the quality of the air flow, even if turbulent and at changing temperatures and pressures.

The Modula range today comes in three configurations – SMART, PLUS and ADAPTIVE – to meet diverse operating needs. A microprocessor, controlled by Piovan propriety software, provides electronic control. The operator's interface is an 8-inch, colour touch screen. The central panel offers access to all the system's components, while each hopper is fitted with local control panel for specific adjustments or settings.

The hoppers have new shock-resistant finish and maintain the exclusive Piovan design which, in addition to ensuring operator safety – independently from the internal temperature, the external surface temperature never exceeds 40°C – also enables maximum thermal exchange between air and the material.