The pre-filtered exhaust air reaches the outside via pipelines and is fed to two biofilters.

Clean exhaust air, save energy

Customized filter solutions in use in the chocolate industry

The processing of cocoa beans produces odour-intensive volatile organic compounds (VOCs). Companies are faced with an important directional decision here: With the right exhaust air technology, not only can pollutants be removed, but energy can also be saved. The Delica company uses this potential within the course of its internal sustainability strategy.

From classic chocolates to small fine chocolate snacks to extravagant chocolate compositions: the traditional Swiss brand FREY from Delica makes every chocolate lover's heart beat faster. The brand not only ensures culinary moments of happiness, but also a clear conscience. Delica takes its responsibility seriously along the entire value chain: from the cultivation and procurement of raw materials to production and consumption.

Due to the energy shortage and the associated increase in energy prices, the topic of energy saving is increasingly becoming the focus of the sustainability strategy. For Delica, this opens new perspectives for making chocolate production more sustainable and at the same time more economical. The clearly stated goal is to reduce energy consumption along the entire value chain.

Chocolate production releases high amounts of pollutants and odours in the exhaust air. Official regulations, complaints from the neighbourhood and environmental protection inevitably lead to powerful filter systems. This is where the wheat is separated from the chaff: In addition to air quality, filter systems differ greatly in energy consumption and thus sustainability and operating costs. Delica filters VOCs and odours using sustainable biofilters and made a conscious decision not to use energy-intensive thermal afterburners.

As a result, Delica saves nearly 300,000 euros (82%) in operating costs and 940 tonnes of CO_2 (90%) annually.

The long way to chocolate enjoyment

Before the end customer can hold his or her melt-in-the-mouth chocolate in his or her hands, the cocoa bean must go through many steps of industrial processing. The fermented and dried cocoa bean, mostly from West Africa, South and Central America, serves as the basis. Before the beans get their typical roasted aromas, the imported goods are checked and sorted. Large plants clean and debacterise the beans afterwards, which causes them to absorb a lot of moisture. This step is carried out under strict conditions to ensure food safety. In the next step, the beans are shelled. By means of a first roasting and a subsequent cracking step, the husk detaches from the beans and is removed by a cross-air flow. Now the pure beans are processed further. In this still moist state, the beans are broken to produce the typical cocoa nibs.

The following processing step roasts and dries the nibs.

A large drum - like a concrete mixer - rotates around the horizontal axis. Due to the spiral rotation, the nibs repeatedly encounter the hot drum wall and after about an hour the roasting of the nibs is completed. The unpleasant smell produced by the roasting process is different from the smell of the finest chocolate mass that one might expect. In addition, there is a high concentration of VOCs in the air. The exhaust air, which is up to 100°C hot and very humid, is transferred to a filter system via a defined fume extraction system.

Combined exhaust air filter system saves energy

The nibs make their way to the cooling vessel, which uses a horizontal air plate with an agitator. After 30-45 minutes of cooling, the nibs have reached the optimal temperature for further processing. The chocolate mill is selected depending on the quality and the final product. The most common are chopping knives, which reduce the size of the nibs. This releases most of the cocoa butter in the beans and produces the raw cocoa mass.

The exhaust air is also heavily polluted during this production step: Fat droplets, VOCs and extreme odours are discharged for filtration. In further steps, the cocoa mass is used to produce a wide variety of chocolate creations.
This intensively polluted exhaust air is typical for the entire food industry. In addition, there are stringent hygiene requirements that most conventional filters are unable to meet.

Delica has opted for an energy-efficient exhaust air filter system from the cross-industry expert KMA Umwelttechnik GmbH to filter out these pollutants and odours in accordance with applicable hygiene regulations.

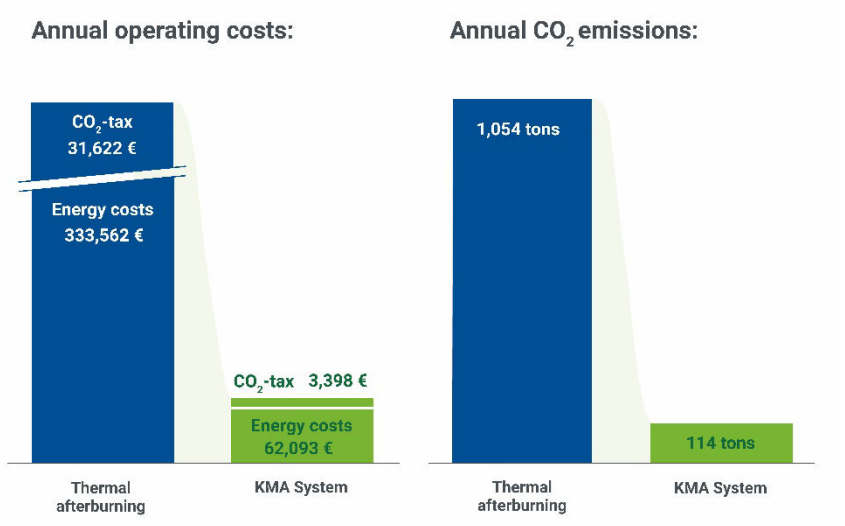
A collecting pipe collects the hot and humid vapour exhaust air from the four roasters, several mills, and a potash reactor (pre-treats cocoa beans for later use as a soluble cocoa drink) and leads it to the filter system.

When calculating the size of the exhaust air technology, great importance was attached to economic efficiency. Measurements on site and extensive calculations led to the result that it is possible to work with a significantly lower exhaust air volume if the four roasters are switched one after the other with a time delay, thus avoiding parallel peaks. Without considerable additional expenditure, the filter system is designed for an exhaust air volume of 6000 m³/h and a temperature of 54°C and a relative humidity of 95% are assumed.

The exhaust air is cleaned of both VOCs and odours by two coordinated filter systems. The pollutant-laden roasting and grinding exhaust air is predestined for a biofilter system. The organic gaseous pollutants can be easily decomposed by microorganisms. But before the exhaust air can pass through this filter medium, it must be cooled, humidified and pre-cleaned with the help of gas scrubbers.

Gas scrubber: Preparation for biofilters

Due to the tight structural conditions, the exhaust air flow is first divided in half and cooled down via two gas scrubbers of 3,000 m³/h each.



Compared to thermal post-combustion, Delica saves 82 percent operating costs and almost 90 percent CO2.

The moisture is removed from the cocoa nibs in the large roasting drum. Right: The three KMA gas scrubbers cool, humidify and clean the cocoa exhaust air in preparation for the biofilter.

The resulting circulating hot water is cooled back down to the temperature required for cooling with the help of a plate heat exchanger and roof re-cooler. The thermal energy gained is available for further use. In other applications, customers use them for certain production steps or to heat the hall, for example. The water from the two scrubbers circulates in a primary circuit and absorbs the thermal energy from the exhaust air flow. From the central collection tank, the common pump draws the heated water and sends it to a water-water plate heat exchanger. This transfers the thermal energy from the water to a secondary glycol circuit, which in turn releases the thermal energy to the environment via a roof recooler. The roof recooler has an independent control and ensures a constant return temperature of the glycol to the plate heat exchanger.

Biofilter: removes VOCs and odours

As a side effect, the air volume is reduced from the original 6000 m³ to 4000 m³, which means that the further exhaust air technology can be designed for a smaller volume. The air is recombined and fed into a third gas scrubber. At this point, filtering of the VOC pollutants begins. An exhaust gas scrubber works according to the absorption principle. The contaminated exhaust air is cleaned with the help of a scrubbing liquid. In the case of VOCs, a caustic soda solution is used.

The scrubbing liquid is sprayed into the exhaust air stream, where the impurities are absorbed and bound by the small liquid droplets.

Finally, the pre-treated exhaust air is directed to the two biofilters, which are flown through in parallel. The last filter step removes almost all VOCs and odours from the cocoa exhaust air. Biofilters are used because of the organic pollutants. As the name suggests, biological material is used to filter the exhaust air. The microorganisms contained in it convert the pollutants into carbon dioxide and water with the help of oxygen. The biological material - consisting of root cuttings and other organic chopped material - lies on a double bottom in the biofilter plant. Sewage sludge is distributed on the surface. This biomass forms the breeding ground for a multitude of bacteria that feel right at home in the humid environment. The polluted exhaust air is blown into the approx. 30 cm space in between the biofilter system. The air flows upwards and makes its way through the perforated floor and then through the two-metre-high biomass layer. The air is 100 % humid due to the previous use of the gas scrubber. In addition, the biomass is sprinkled at times to keep the surface moist enough for the bacteria. To moisten the biomass, a sweat hose is placed on top of it, through which a defined amount of water flows at regular intervals. The bacteria decompose the VOCs naturally, resulting in odourless and almost pollutant-free air.

Biofilters are particularly popular because they entail only low operating costs. The biomass is only replaced every two to five years and energy consumption is limited to air transport.

90 percent carbon dioxide saved

Delica operates an ISO 14001 certified sustainability management system. This ensures that the goals of the sustainability strategy are consistently implemented. With the installation of a resource- and energy-efficient exhaust air filter system, the company can operate even more sustainably. The conscious decision not to use a conservative filter method clearly shows that over 5,200 MWh of gas and thus 940 tonnes of CO_2 are saved annually. This saves the chocolate manufacturer almost €300,000 in operating costs per year. In this way, Delica not only treats the environment responsibly, but also creates a decisive competitive advantage for itself. The example clearly shows that integrating exhaust air purification into production planning leads to significant energy savings. In many food industries, the deliberate combination of the energy-efficient exhaust air purification process with intelligent heat recovery systems improves production-side energy efficiency even further. Based on several key figures, the KMA operating cost calculator can be used to make individual statements on energy savings. ■

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