

# MASTERING EXTERNAL CONTROL PARAMETERS FOR AGING AND DRYING RAW SAUSAGE

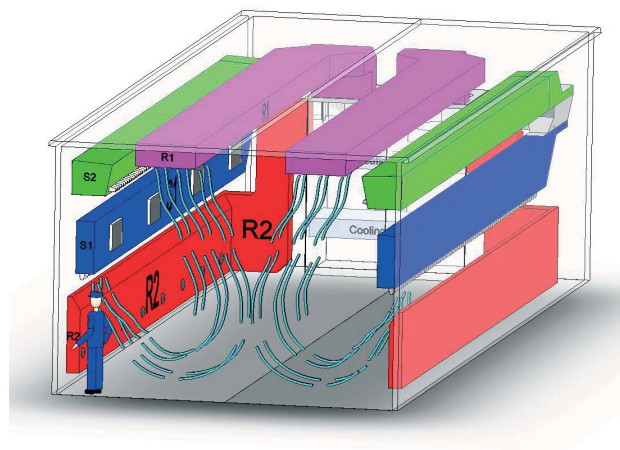
**Standardized products with uniform high quality: this is the ambitious goal of the meat-processing industry when making its artisan products. Choosing the right climatic system is a vital necessity. State-of-the-art CLIMAJet post-aging systems from Schröter Technologie GmbH & Co. KG offers simple ways to meet even the highest standards.**

Increasing raw material and energy prices drive producers to further increase the quantitative efficiency of their production quantities with minimal time expenditure. In addition, consumers are placing an increasing degree of importance on sustainability and intelligent resource use. No less important is product safety, especially when it comes to raw-sausage production. Defined pH reduction and drying ( $a_w$  value) in all equipment areas makes a significant contribution to product safety, uniform drying, and the marketability of manufacturer products, and it enables even packaging, e.g. for salami snacks or other thin-caliber raw sausages. For these reasons, the consistent, reproducible treatment of such products is of great importance. Whether production quantities are large or small, equipment technology is the decisive factor for creating optimum quality.

## EXTERNAL INFLUENCING FACTORS FOR AGING RAW SAUSAGE

An extensive number of microbiological, chemical, and physical processes take place when aging raw sausage that affect preservability and sensor technology. These processes interact with one another – and some even depend on one another. These aspects highlight the importance of equipment technology precisely tailored to the products it produces. Although the inner parameters, such as fat and salt content or grinding levels, and product caliber (geometry) are predefined<sup>1</sup>, the equipment technology is responsible for the external factors. These parameters include relative humidity (%), temperature (°C) air speed (m/s), and flow direction. The arrangement of the goods in the treatment room and the loading of the smoker wagon are user-controlled factors that also influence the drying process.

The parameters of air speed, relative humidity (or humidity difference between the product and the treatment air), and the permeability of the sausage casings used impact outer diffusion<sup>2</sup>. Water-transport processes inside the product are referred to as inner diffusion. The grinding level, fat content, and intestine caliber (diffusion path) are the major influencing parameters. They must be well defined and the external influencing parameters must be adjusted for them to avoid defective products. When more water is removed from the product surface than is supplied from the inside of the product, the result is periphery compression (caused by protein-matrix shrinkage) and, combined with the increased salt content due to drying, damage to myofibrillar proteins. A slightly dried periphery is generally reversible; in such a case, the equipment should be turned off and the product should be left to rest for 12–24 hours with constant monitoring. The over-dried periphery is normally “rehumidified” thanks to



The CLIMAJet DR multichannel drying system is designed for especially high drying rooms.

the inner product moisture and the aging process can continue; however, diffusion behavior is less ideal for these products due to the dried periphery. This aspect should be taken into consideration during subsequent process control.

If the drying on the periphery is too strong or has progressed too far, the process is often irreversible. The pH value should also always be considered a key process variable in addition to the  $a_w$  value during process control. Drying sausage products should only then commence when the desired color maturity has been achieved. If the drying process continues before the desired color has been reached, the myoglobin configuration that exists at that moment is set; i.e. insufficient reddening on the periphery will lead to irreversible color defects. After filling, the product should then be brought to aging temperature either very slowly using graded temperatures or as quickly as possible.

This process reduces the formation of undesired condensation. The sausages are slightly hygroscopic due to salt content between 2.4–2.8%, allowing them to absorb the water. That fact leads to a weight increase of up to 1.5%, which, in addition to an extended drying duration (about one day), also means an increased microbiologic risk. Myoglobin on the periphery can also be “washed out,” which can lead to a more instable and, in certain cases, more faded color. The sausages are then pre-aged with the initial priority of activating the added starter cultures. After activation has taken place, the desired and key pH value reduction caused by the metabolization of added sugars through the starter cultures, which, in turn, positively influences the color, preservability, cut resistance, and flavor development.

When the pH value sinks below a value defined for the product (5.3 for many products), the products can be dried to a greater

<sup>1</sup> Cf: Rödel W. (1985): Rohwurstreifung, Klima und andere Einflussgrößen, Kulmbacher Reihe Mikrobiologie und Qualität von Rohwurst und Rohschinken, Bundesanstalt für Fleischforschung

<sup>2</sup> Cf: Stiebing A. (1997): Herstellung von Rohwurst, Handbuch für Fleisch und Fleischwaren, Behrs Verlag

degree and, if desired, smoked. The speed of pH reduction is determined by the defined sugar type and quantity, starter cultures, and, above all, the aging temperature. Depending on the product and country of production, some of the temperatures can range from 20–30°C (Europe), 35–50°C (Asia), and 50–60°C (North America). The equipment technology and process control should be adapted to each individual product. After the initial drying or smoking, the goods are either packaged (fresh, quickly aged products) or “final aged” in special post-aging and drying rooms until the desired weight reduction is achieved. In these rooms or equipment, the correct air flow for each specific product is just as important as the perfect humidity and temperature control for that product.

As a result, different systems make sense for each individual product. The Schröter CLIMAJet cold-smoking systems with the Multi-Air-Flow (MAF) System is perfect for quickly aged, thin-caliber products; a combination of the standard CLIMAJet cold-smoking system and CLIMAJet post-aging is ideal for thick-caliber, well-aged products. The CLIMAJet DR (drying rooms) (fig. 1) is particularly well suited for high rooms. The uniform product drying increases and decreases with tailored control options for air-flow types and speeds. The CLIMAJet NR's uniform air flow ensures consistent drying losses (fig. 2) in the post-aging process. The drying and dehumidification features are tailored to each specific product, allowing for even, gentle meat product handling even in the largest post-aging rooms. A positive side effect: weight-precise drying allows for reduced filling weights and thus noticeably improves the overall operating process. With the CLIMAJet KR with Multi-Air-Flow, the injected air cyclically alternates between vertical (centric) and horizontal (lateral) air feedback (fig. 3). This process guarantees maximum consistency for critical products, i.e. meat products that are difficult to dry and for which only minimum deviations are permissible.

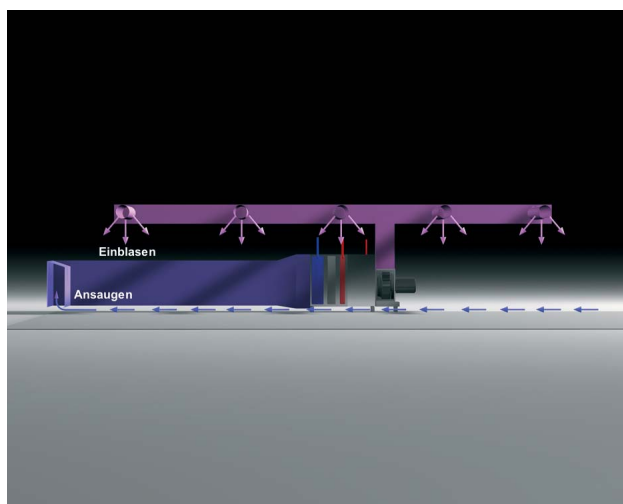
#### PROCESS CONTROL: AUTOMATED CLIMATE AND FRESH AIR

In addition to the classic climate processes in which only the treatment air in the process room's circulation system is conditioned, the use of automatic fresh-air systems fresh air systems and alternating process control (e.g. in LIMIT operations) is also possible. Schröter fresh-air system offer constant monitoring for ambient air temperature and humidity, which is continuously fed to the treatment room using a state-of-the-art computer system. If, for example, the ambient air is suitable for product drying, then more fresh air is added and the cooling register is increasingly taken from the ambient air drying and thereby generating substantial energy savings.

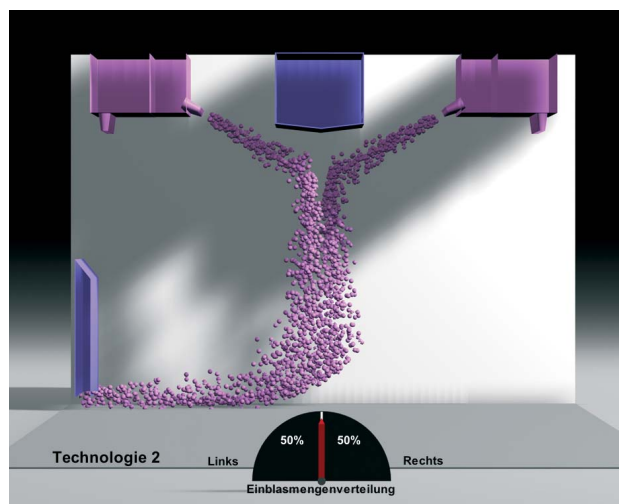
#### LIMIT operations enables the following advantages:

- > Product-specific drying
- > Direct influence of product characteristics (pH value,  $a_w$  value, fat content, etc.)
- > Reduction in aging mistakes
- > Low energy consumption thanks to shorter operating periods
- > Low energy consumption thanks to unnecessary humidification
- > Low maintenance requirements thanks to short operating times
- > Increased longevity of motors and machine parts

No constant humidity difference between the relative humidity and the  $a_w$  value for the products are predefined but rather an interval consisting of minimal or maximum temperature and humidity values. These parameters entail a constant alternation between operating and standby periods. During the standby phase (reduced air circulation with deactivated media), the products' moisture diffuses from the core to the periphery and the surface where it is picked up by the circulating air, which then increases the relative humidity in the chamber (humidity buildup through its own moisture).



CLIMAJet's even air flow for post-aging units ensures uniform drying losses. The air-injection channels are located on top and the return air channels are on the left.



The classic cold-smoking solution with Multi-Air-Flow (Technologie 2) is perfect for small-caliber products that are difficult to dry.

The diffusion speed (drying rate) slows down as the aging and/or drying process continues, creating a sawtooth curve. Approaching a final value, the highest point in the moisture buildup is equalized for the maximum level of readiness for moisture release in the products. This is known as the outer limit value (plus plus) in the LIMIT process and can be adapted to each specific product and its characteristics. When the outer limit value (plus plus) has been reached, the break time is over and the operating period begins. During the operating period, the predefined internal limit values (plus) are regulated (moisture decrease) using an increase in ambient air and by connecting the necessary media (cooling, heating, drying, humidification). When the minimum limit value (plus) has been reached, the unit switches to standby and the climate is once again established on its own thanks to the humidity given off by the product.

This type of control process decreases energy consumption and is a gentle drying method (without time loss), particularly for raw sausage and raw ham, since the climate (relative humidity) in the chamber is created solely due to the products' readiness to release moisture, which achieves maximum drying speeds.

Another advantage: short operating times. As opposed to climate operations (consistent humidity difference), the drying process does not involve constantly taking moisture from the product but instead only removes the humidity from the ambient air. As in all process steps, the power of Mother Nature – fresh air – is involved using the latest enthalpy regulation in the LIMIT process.

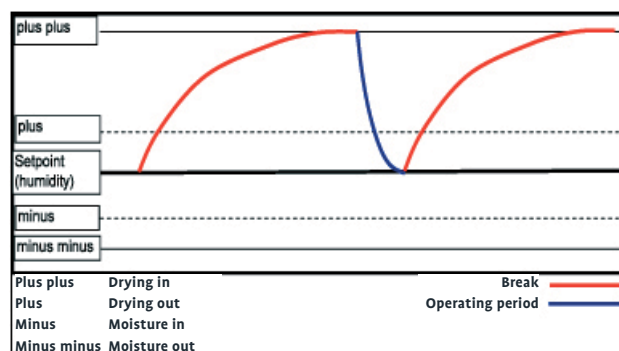
An additional assurance against excessive product drying (e.g. through reduced chamber loading, product-based, or mechanical influences) is an adjustable “negative” maximum deviation from the target value (minus minus) whereby the unit targets the normal limit region (minus) through additional moisture in the case of a lower deviation.

#### PRECISE WEIGHT REDUCTION SAVES TIME, WORK, AND COSTS

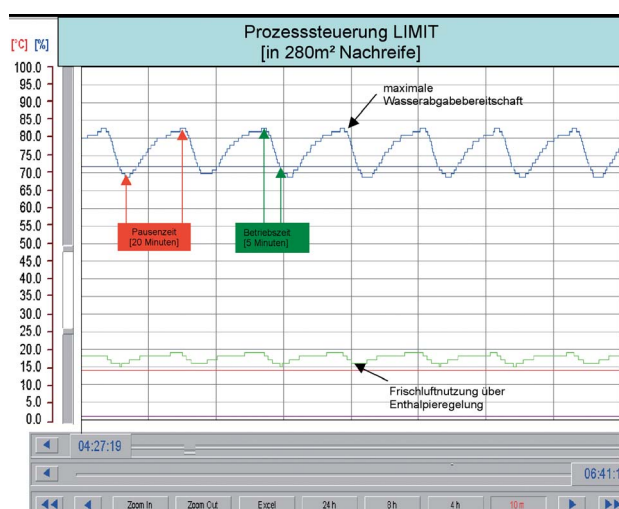
Strict adherence to raw materials and production standards must be taken into consideration as early as during the production process before moving on to the optimum subsequent drying and smoking in the cold-smoking unit. Unequal weight loss makes the subsequent packaging process more difficult and considerably increases expenditures. The cutting-edge CLIMAJet system allows for even drying thanks to modern programmable memory (PLC), precise monitoring for all relevant parameters, and a changeover damper. The latter ensures optimum air distribution – known as air roll. The changeover damper “drives” the air roll through the chamber with a high degree of accuracy, supplying all products in all areas with consistent, conditioned treatment air. The result is guaranteed uniform aging and drying conditions throughout the entire treatment room – in addition to clearly defined product quality.

#### SUMMARY

Efficient, high quality products can only be created using high-quality, cutting-edge equipment technology and high raw-material and production standards – and Schröter offers the right equipment for meeting those standards. The fact that



Theoretical humidity process in LIMIT operations



Real-life example: limit process in 280 m² post-aging (salami and ham aging)

each piece of equipment is custom tailored to each individual client and product allows any product or request to be handled. All units are manufactured using the highest quality standards, guaranteeing low maintenance costs and decades of operational readiness in accordance with the slogan: Leading Quality!