



## **Kammerer-sluiice-systems in the FREEZE DRYING OF COFFEE**

**The freeze drying method is a process used in the production of pharmaceutical products and medication, e.g. anti-biotics, blood-plasma, vaccacines as well as in food, and has proved itself to be very successful.**

**This process is very expensive and is thus used in the production of valuable substances, sometimes products which are sensitive to temperature. They may be stored at room temperature and may be used immediately if needed.**

**This freeze drying method of preserving substances in which the cells keep their original properties and effect making it possible to return to the original substance by dissolving the dried material in a liquid. The quality remains unchanged and stays in its original high-quality-condition. In pharmaceutical products this preservation-method on one or the other properties of pharmaceutical products can mean a life-saving property because of having been influenced by this freeze-drying-method.**

**In cooperation with our customer that has been with us for decades DEUTSCHE EXTRAKT KAFFEE GMBH (DEK) in Berlin we would like to introduce for the food industry an exemplary method using the Kammerer-slide-gate-valve. The Kammerer-sluiices and slide-gate-valves have been integrated into various key positions during the manufacturing process, fulfilling, different functions simultaneously. The Kammerer-sluiice-systems have been proven to be reliable solutions.**

### **DEUTSCHE EXTRAKT KAFFEE GMBH**

Today DEUTSCHE EXTRAKT KAFFEE GMBH (DEK) in Berlin is part of the Cafea-Holding with its headquarter in Hamburg. The foundation for the Berlin plant was laid in 1969. This reputable coffee-manufacturer, widespread in Germany, has amalgamated to prepare the way for the manufacture of coffee in Germany under the auspices of the manager Mr. Jan Beernd Rothfos. From then on this plant has served as an example for the first coffee manufacturing plant in Germany. The DEK has specialized in the production of instant coffee offering several variations. This high-quality-coffee is produced in the freeze-drying-plant quasi-continually in a 24-hour-production-operation. The production building is 35m high and comprises 5 storeys. The production plant has been supplied with the Kammerer-shut-off-solutions since its infancy.

### **Coffee-production within in the scope of the freeze-drying**

Freeze-drying is compared to the classic spray drying and the agglomeration method, the best-known method of protecting the product comprising the 800 various aroma products of the taste of the first-class coffee-bean. It is also called lyophilisation or drying by sublimation. This is a method of transferring frozen ice matter under vacuum directly in gas-form, without becoming a liquid. The granules, known as instant coffee, are produced within the framework of this method following strict purity requirements – as a rule in four process steps. These steps are described in the following paragraphs and the usage of the Kammerer-slucice-systems are described in the corresponding positions.

#### **1. The raw coffee beans are roasted and ground.**

Different kinds of raw coffee beans are cleansed and transmitted to drum roasters, in which they are subjected to 200°C – 230°C. Each coffee bean contains water which condenses during the roasting process. Coffee, which is the basis for the later instant coffee, is due to the water content darker than filter coffee. The roasted coffee is then ground, according to the size of the granules. In this way possible blockage in the following step is avoided.

#### **2. The ground raw coffee is extracted.**

Extraction is the separation of the soluble components of coffee by means of water and pressure. The result is a liquid extract. The extraction itself occurs in a serially-connected, steel extraction columns in a counter-current-process. These columns are filled with freshly-ground coffee alternately whilst the extracted coffee is being separated. During the extraction process the water is pressed at a temperature of 170°C to 190°C through the different columns, until the liquid coffee extract is cooled down at a temperature of 40°C to 80°C. The extracted coffee is then filled into silos in a concentrated form.

### 3. Deep-freezing and drying of the liquid coffee

The liquid coffee is frozen to  $-20^{\circ}\text{C}$  until it becomes a thicker consistency. Ice crystals are formed and the coffee looks like soft ice cream. Only in this consistency can it be sprayed onto a steel-frozen-conveyor-belt and sent into the freezing chamber. The coffee is frozen to  $-50^{\circ}\text{C}$  turning into a brown ice block with a width of 1m and a thickness of approx. 1cm. By means of shock-freezing little ice crystals are formed, which do not destroy the plant cell walls.

Then the coffee is ground and filtered. In this freezing chamber the first **Kammerer-charging-slucices (see fig. 1)** can be found. These consist of two absolutely vacuum-tight Kammerer-shut-off-valves of the GPT-type: the upper valve is a product-tight-valve and the lower one is a vacuum-tight-valve. Both Kammerer-valves are linked to one another by a pipe section which lock together. The sealing of the GPT-type occurs by means of O-rings. The frozen coffee is collected on the upper slide gate valve avoiding the entry of possible coffee particles and coffee dust from getting into the sealing system of the lower vacuum slide gate valve. The upper slide gate valve is opened should a specified portion have been collected on it, allowing the frozen coffee to drop down into the pipe section and onto the lower vacuum-tight-valve. The upper product-valve is closed, the pipe section is placed under vacuum and the lower slide gate valve is opened. The product drops into an agitator vessel, in which the frozen coffee is mixed again, after which it goes through the second Kammerer-slucice-system leaving the freezing chamber to get into the vacuum disc dryer. The combination of the "slucice-vessel-slucice" is placed threefold side by side.



Fig. 1: Kammerer-charging sluices

In the event of one combination failing or for maintenance purposes the quasi-continuous process control can be continued without any interruption. The **KAMMERER-transition-sluice** then fulfills the most demanding requirement. This procedure is to ensure the smooth transition of the frozen material to the vacuum. The ground and frozen coffee is collected onto the upper product-valve until it reaches a specified quantity, then this product-valve opens, the frozen coffee drops in the connecting pipe on the vacuum-valve which is placed under vacuum until it reaches the vacuum of the disc-dryer of 0.3 mbar. The lower vacuum valve is opened and the coffee leaves the freezing chamber and is collected in a silo. This absolutely reliable tightness and robustness of the Kammerer-sluice avoids any additional backing-up of the coffee into the freezing chamber. The plant is set up in a way that a backing-up directly leads to an automatic switching-off of the plant. In the following step the ice in the coffee granules has got to be sublimated under vacuum.

#### 4. Drying of the coffee in the vacuum disc dryer

The silo is on top of the vacuum disc dryer and serves as a portion-divider. It ensures a continuous amount of the product falling onto the individual disc in the vacuum dryer. These discs, approx. 30 in number, are heated to 45°C in the upper section, increasing to a temperature of 125°C as it reaches to lower section. The coffee granules are dispersed from disc to disc. Simultaneously the coffee is mixed, while the moisture is extracted. Filters are attached directly to the disc dryers which separate impurities and dust from the coffee. At the back condensers collect the moisture at this point. At the bottom of the discs silos are built in making it possible to have a final quality control procedure before the packing of the coffee granules. **Kammerer-sluices (see fig. 2)** are attached directly underneath for a final discharge. This enables the discharge of the purified instant coffee granules ready for use after leaving the silos. The sluices consist of two absolutely-vacuum-tight Kammerer-slide-gate-valves of the ST-type. Again the product is collected on the upper slide gate valve. Having reached a particular weight the upper slide gate valve is first opened, so that the coffee can flow following this. This is strengthened by an inflatable seal. – then is closed and the pipe section is set under atmosphere. Because of this lower slide gate valve is opened so that the coffee is portioned and filled into 400kg-big-bags. The big bags are then shipped to the headquarter in Hamburg, where they are packed into the usual customary packings and sold so that the coffee finally can be served to the coffee connoisseurs.



Fig. 2: Kammerer-discharge sluices

### **Advantages of the freeze drying**

The advantages of freeze drying are that the process of first freezing and then drying under vacuum maintains the original cell-structure and thus the taste and texture without changing the optical appearance. The coffee is only slightly affected therefore maintaining the highest quality. Simultaneously the drying procedure leads to an interior de-hydration facilitating its reuse at a later date. Aroma substances can be preserved in a better way by means of the coldness and the absence of local atmospheric conditions thus preventing any reactions. The product can be stored at room temperature and later used without having to be cooled or treated chemically.



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