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| <b>"Mineralcommerce" JSC</b> |                     |                               |                       |
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**MINERALCOMMERCE AD**

**Technological documentation**

**Food additive E551 –**

**EUSIL F**

|                     | <b>Last name</b> | <b>Position</b>    | <b>Date</b> | <b>Signature</b> |
|---------------------|------------------|--------------------|-------------|------------------|
| <b>Developed by</b> | Chavdar Gadzhev  | PRK                | 15.09.2025  |                  |
| <b>Approved</b>     | Dimitar Tomov    | Executive Director | 15.09.2025  |                  |

## **I. DEFINITION**

The technological documentation refers to the production of EUSIL F - food additive E551. Precipitated amorphous silicon dioxide with a certain specific surface area and particle size, of a polishing-thickening type with a high degree of purity, aggregation in the micrometric range. Bifunctional - in addition to good abrasiveness, it also has good thickening ability.

It is used as a substance in the production of antibiotics, in cosmetics - as an abrasive and thickener for toothpastes, and in the food industry - as a food additive, serving as an anti-caking agent.

### **Product composition :**

SiO<sub>2</sub> - 98.9 %

Al – 0.165%

K – 0.122%

Ca – 0.641%

Fe – 0.192%

The precipitation of silica is carried out in a reaction synthesis column. Initially, the required amount of water is supplied until a certain temperature is reached. The water glass is supplied at a certain rate, while at the same time gaseous carbon dioxide is supplied with a set flow rate. To reach and maintain a certain temperature, steam with a pressure of 6 atm is used, which is supplied in a steam jacket.

Active silica is continuously precipitated from the solution, which is due to the following chemical reaction:



After sedimentation is complete, the unwashed suspension is drained into a sump equipped with a stirrer to prevent further sedimentation.

The process continues in a continuous pattern, with the specified hourly flow rate of suspension being fed for continuous filtration to drum vacuum filters, in which the carbonates are washed with water through nozzles. Depending on the amount of sodium oxide (Na<sub>2</sub>O) in the unwashed suspension, the flow rate, the amount of water, and the speed of the drum vacuum filters are determined. From the collector, by means of a screw pump, the silica suspension is fed into the trough of the first drum vacuum filter.

After the first drum vacuum filter, the suspension is fed into the trough of the second drum vacuum filter by means of a screw pump.

The washed suspension is fed into a mixer, simultaneously with sulfuric acid with a concentration of -10÷15%, while monitoring the pH with a pH meter and in the laboratory

within the range of 5.5÷6.5. The acidified washed suspension is fed into collectors (4 pieces) equipped with mixers .

This is followed by drying, which is carried out in a vacuum drying installation equipped with a natural gas burner, a combustion chamber, 2 cyclones, a filter (bag filter type) for separating flue gases from the product and a hopper for the finished product. The washed suspension is fed by a screw pump to a high-speed spraying device. At an inlet temperature of 600 °C. The powdered product falls through the rotary shutters of the drying chamber and the cyclones into a pneumatic transport path and a transport fan and reaches the hopper for the finished product. A disintegrator is used for additional grinding.

Next, the finished product is packaged in a vacuum filling machine in paper porous valve bags.

The paper bags are stacked on pallets, which are then transported by roller conveyor to a finished goods warehouse.

| Indicators                         | Specification limits | Standard/calculation methods |
|------------------------------------|----------------------|------------------------------|
| Silica on dry basis                | Not less than 94%    | DIN 55921                    |
| Humidity, 105°C                    | 6.0 max              | ISO 787/2                    |
| pH, 5% suspension                  | 6.0 – 7.5            | ISO 787/9                    |
| Oil absorption with glycerin g / g | 4 , 5 minutes        | ISO 787/5                    |
| Losses on ignition, % at 1000°C    | 8%                   | DIN 53580 (1968)             |

## **II . CLASSIFICATION**

Eusil F – is included in Regulation 1333/2008 on food additives.

It is classified in Annex 1 as an anti-caking agent and in Annex 2, Part B, item 3 Additives other than colours and sweeteners. - under No. E551.

## **III. TECHNICAL REQUIREMENTS**

The following raw materials, auxiliary and packaging materials are used for the production of EUSIL F:

1. crystalline sodium water glass
2. softened water
3. direct water vapor
4. CO<sub>2</sub>
5. H<sub>2</sub>SO<sub>4</sub>
6. Paper bags
7. Wooden pallets

## 8. Stretch film

All raw materials and packaging materials are supplied with certificates of analysis.

### **IV. CONTROL INDICATORS**

#### **Quality control indicators for EUSIL F – food additive E551**

1. Water glass solution /raw material/
  - Relative weight in acceptance and issuance per shift of each collection 1.19–1.21 g / sm<sup>3</sup>
  - Na<sub>2</sub>O – when accepting and issuing a shift per collection 5.5 – 6.0 %
  - Module - upon receipt and issuance per shift of each collection 3.0 – 3.5
2. Suspensions  
First synthesis column balance – 1 shift
  - SiO<sub>2</sub> 4.9 – 7.0%
  - Na<sub>2</sub>O 1.75 – 2.30
  - pH of each cycle – pH<sub>0</sub>, pH<sub>1</sub> - 15 min , pH<sub>2</sub> - 40min, pH<sub>3</sub> - final 8.3 – 8.4
3. Washed suspension – 1 change
  - Na<sub>2</sub>O – every two hours 0.12 – 0.16%
  - Si<sub>2</sub>O – every two hours 12.0 – 14%
  - Relative weight 1.09 – 1.13
4. Acidified suspension – per collection
  - SiO<sub>2</sub> > 12 %
  - pH 5.5 – 6.5
  - Relative weight 1.09 – 1.13
5. Finished product
  - From pneumatic transport
  - specific surface area 4 g
  - moisture 3.5 – 4.5%
  - bulk weight >160g/dm<sup>3</sup>
  - pH 5.5 – 7.5
  - oil absorption min. 4 , 5

#### **Physico-chemical indicators for control:**

The manufactured product must meet the following requirements:  
Appearance: white powder

Silicon dioxide (dry matter)  $\geq 96\%$ .  
Moisture at 105° -  $5.5 \pm 1.5\%$   
Losses on heating (1000° C) – max . 7.0%.  
Specific surface area  $\geq 220 \text{ m}^2 / \text{g}$  .  
pH of 5% suspension of finished product – 6.0 – 7.5  
Bulk uncompacted weight max .  $220 \text{ g} / \text{dm}^3$   
Oil absorption with glycerin min .  $4.5 \text{ g} / \text{g}$   
absence of metal impurities

### **Microbiological indicators**

The microbiological indicators for monitoring EUSIL F are:

|                  |                |
|------------------|----------------|
| Escherichia coli | is not allowed |
| Salmonella spp   | not allowed    |

Microbiological indicators are tested in an external accredited laboratory, and the test protocols are stored until the expiration date of the tested sample.

### **V. RULES FOR SAMPLING AND METHODS FOR ANALYSIS OF EUSIL F – food additive E551.**

Acceptance and sampling is carried out according to: ISO 5794-1, ISO 787-11, ISO 787-2, ISO 3262-1, ISO 787-9, ISO 3262-19

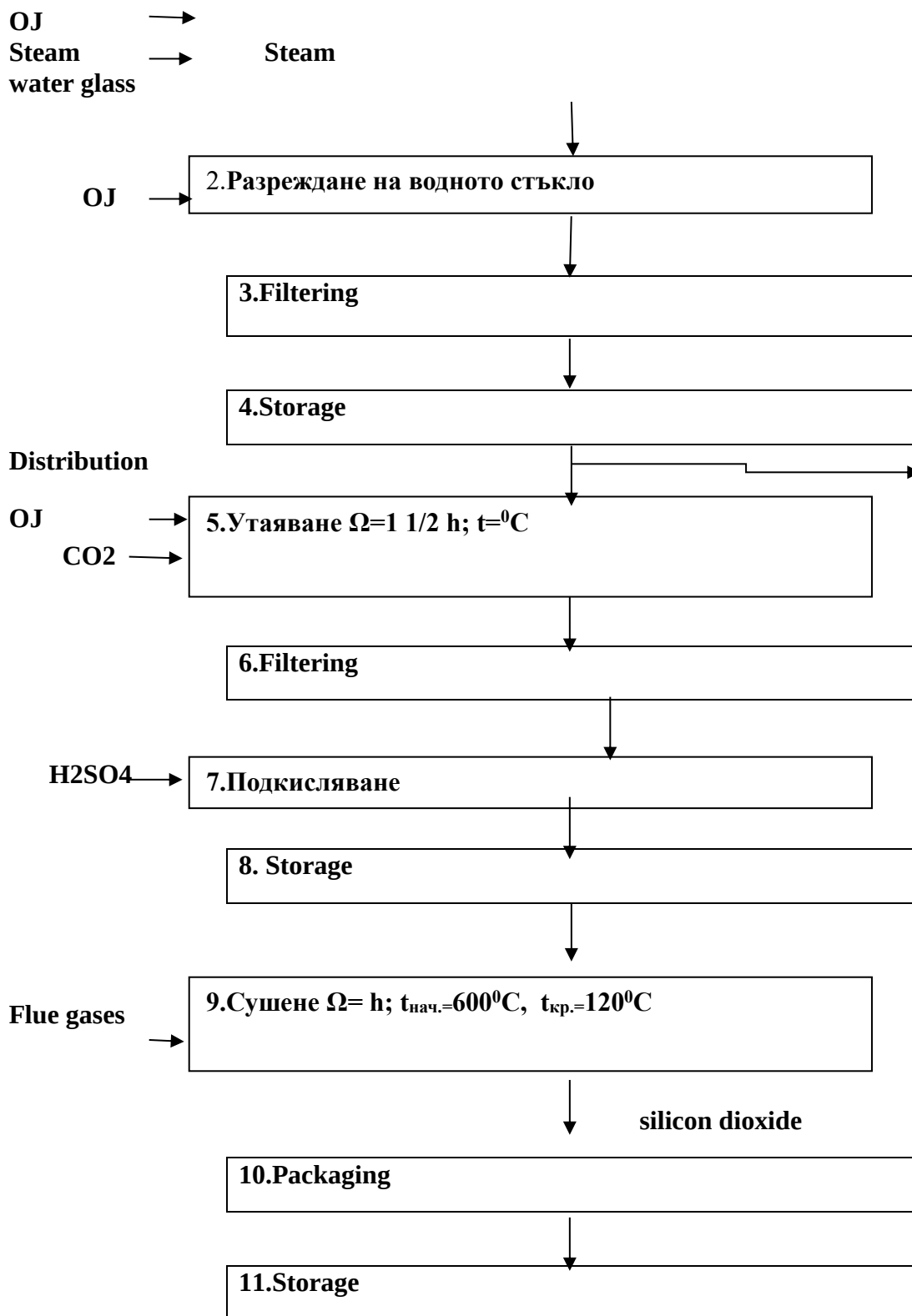
1. Taking a sample from a storage container for liquid aqueous sodium glass with a dried, clean beaker –  $500 \text{ cm}^3$  of sample is taken, initially allowing a small amount to flow out of the tap. The sample is tempered to room temperature.
2. Taking a sample from the synthesis column – due to the high temperature The sample is taken in an Ellermeier cup with a handle.
3. Filter - a sample of the flowing suspension is taken with a beaker - 50 ml - before acidification and 250 ml - after acidification
4. Collection of ready suspension - the sample is taken in a beaker - 250 ml after letting a small amount run out of the tap.
5. Drying – finished product. The sample is taken in a plastic container with a volume of  $500 \text{ cm}^3$  from cyclone by opening valve
6. Filling machine – a sample is taken with a laboratory spatula at each tenth bag.

### **V I . TECHNOLOGICAL PROCESS**

Acceptance of crystal water glass



1.Топене на кристалното водно стъкло  $\Omega=6 \text{ h}$ ;  $P=6 \text{ atm}$ ;  $t=120^\circ\text{C}$



## 1. Machinery and equipment

Preparatory department:

- Overhead crane
- Container

- Autoclave – 2 pcs.
- Water glass tanks – 2 pcs.
- Filter press

#### Synthesis (precipitation) of silica

- Water glass collections – 4 pcs.
- Synthesis column

#### Filtering

- Collection of unwashed suspension
- Drum vacuum filters – 2 pcs.
- Separator

#### Acidification

- Washed suspension collection
- Sulfuric acid collection
- Sulfuric acid acidification kit
- Collections for acidified suspension – 4 pcs.

#### Drying

- Oven
- Gas burner
- Drying chamber
- Sprinkler
- Block-cyclone
- Bag filter
- Chimney
- Microbiological filter

#### Packaging

- Vacuum packaging machine

#### Labeling

- Sticking a label with glue on the bag

#### Storage

- Store in a dry and ventilated place.

#### Transportation

- The product is transported stretched on wooden pallets.

## **2. Preparation of raw materials**

The received raw material goes through stages of melting, dilution, filtration, storage

The raw material - crystalline sodium water glass, is poured into a container with a conical bottom by means of a bridge crane, which serves to charge the autoclave, where the required amount of softened water is initially charged. After filling, the hatch is closed and it is brought into rotational motion by the electric motor. At the same time, direct steam is released along the axis of the autoclave. When the pressure reaches 5 atm. the steam supply is stopped.

After 6 hours, the crystalline sodium water glass passes into solution. The autoclave is stopped and, using a drain valve, the solution enters a cement tank. Depending on the desired density, the water glass is diluted. The coarse mechanical impurities settle in the cement tank. From there, the solution is fed to a filter press using a centrifugal pump, where fine cleaning is performed. The purified water glass is collected in collectors, from where it goes through various processes to obtain precipitated silica.

### **3. Technological process**

Precipitation is carried out in a reaction synthesis column. Initially, the required amount of softened water is supplied until a certain temperature is reached. The water glass is supplied at a certain rate, while gaseous carbon dioxide is also supplied at a given flow rate. Air is also supplied for stirring. To reach and maintain a certain temperature, steam with a pressure of 6 atm is used, which is supplied in a steam jacket. Active silica is continuously precipitated from the solution.

After sedimentation is complete, the unwashed suspension is drained into a sump equipped with a stirrer to prevent further sedimentation.

Further, the process is carried out in a continuous scheme, as the determined hourly flow of suspension is fed for continuous filtration to drum vacuum filters, in which the carbonates are washed with softened water through nozzles. Depending on the amount of sodium oxide ( $\text{Na}_2\text{O}$ ) in the unwashed suspension, the flow rate, the amount of softened water, and the speed of the drum vacuum filters are determined. From the collector, by means of a screw pump, the suspension of silicon dioxide (white carbon black) is fed into the trough of the first drum vacuum filter. After the first drum vacuum filter, the suspension is fed into the trough of the second drum vacuum filter by means of a screw pump.

The washed suspension is fed into a mixer, simultaneously with sulfuric acid with a concentration of  $10\div 15\%$ , while monitoring the pH using a pH meter and in the laboratory within the range of  $5.5\div 6.5$ . The acidified washed suspension is fed into collectors (4 pieces) equipped with agitators.

This is followed by drying, which is carried out in a vacuum drying installation equipped with a natural gas burner, a combustion chamber, 2 cyclones, a filter (bag filter type) for separating flue gases from the product and a hopper for the finished product. The washed suspension is fed by a screw pump to a high-speed spraying device. At an inlet temperature of  $600^\circ\text{C}$ . The powdered product falls through the rotary shutters of the drying chamber and the cyclones into a pneumatic transport path and a transport fan and reaches the hopper for the finished product. A disintegrator is used for additional grinding.

Next, the finished product is packaged in a vacuum filling machine in paper porous valve bags.

The paper bags are stacked on the pallet, which is then transported by roller conveyor to a finished product warehouse for stretching.

#### **4. Technical characteristics of the workplace – synthesis**

- Water glass solution kits

$V = 25 \text{ m}^3$  h - 3660 mm d - 3000 mm

Working volume –  $22.6 \text{ m}^3$  Dead volume –  $2.82 \text{ m}^3$

$V = 40 \text{ m}^3$  h - 3 00 0mm d - 6 000mm

- Softened water collection

$V = 40 \text{ m}^3$  h - 600 0mm d - 3000mm

Working volume –  $37.9 \text{ m}^3$  Dead volume –  $2.1 \text{ m}^3$

- Reaction column

$V = 13 \text{ m}^3$  h - 10350 mm d - 1 300 mm

The reaction column is a vertical cylindrical vessel with a conical bottom above which a bubble grid is located. The supply of  $\text{CO}_2$  and air occurs in the lower part of the column under the bubble grid. The supply of water glass occurs through four spray nozzles above the grid. The supply of OB occurs in the upper part of the column. The temperature is maintained by a steam jacket.

- Liquefied  $\text{CO}_2$  collection

The evaporator is heated with steam, which distills and maintains normal operating pressure of  $\text{CO}_2$ . When  $\text{CO}_2$  is consumed, the pressure and temperature drop, so steam is periodically supplied to the evaporator to maintain them within certain limits (17.5 - 18.5 bar pressure).

- Heat exchanger

Heat exchange surface –  $38 \text{ m}^2$

The vessel is located horizontally, consists of a tube and an intertube space. It serves to preheat softened water supplied to the reaction column. As OB it is supplied to the tube, and the steam to the intertube space.

- Collection of unwashed suspension

$V = 25 \text{ m}^3$  h - 3660mm d - 3000mm

It serves as a buffer vessel between the reaction column and the filtration stage. Equipped with a stirrer that prevents the suspension from settling.

- Centrifugal pumps

W =4 kw 2080 rpm h -30 m flow-3 m<sup>3</sup>/hour

W =4 kw 2870 rpm h -40 m flow-8 m<sup>3</sup>/hour

Serves to transport water glass solution from the collectors to the reaction column

- Centrifugal pump

W =11 kw 2900rpm h -31 m flow-45 m<sup>3</sup>/hour

It serves to transport OV from the softened water collector through a heat exchanger to the reaction column.

- Centrifugal pumps

W =22 kw 2940rpm h -54 m flow-45 m<sup>3</sup>/hour

They serve for recirculation of water glass, as well as for returning water glass to the collection preparation compartment.

- Multistage vertical pump

W =5.5 kw 2900 rpm h 81-33 m flow rate 8-24 m<sup>3</sup>/hour

The pump is equipped with a frequency inverter, through which the speed and, accordingly, the flow rate are regulated. It serves to transport water from the fresh water tank through the chemical water treatment plant to the RW tank. The pump control is manual and automatic.

- Softening installation

It consists of two collections operating in a certain mode.

Volume - 500l. amount of ion exchange resin - 425l. (for one collection)

The function of the installation is to remove calcium and magnesium ions, which determine the overall hardness of the water. This is done with the help of the ion exchange resin, which after a certain time is exhausted and loses its functions, for this reason it is regenerated with a solution of sodium chloride. For this, the two vessels operate in different modes, although they are interconnected. When one collector is in operating mode, the other is in standby or regeneration mode. The hardness of the water is determined in the laboratory.

- Compressor

Maximum pressure – 7.7 bar

Normal operating pressure – 7.0 bar

Flow rate – 13.59 m<sup>3</sup>/min

Maximum operating temperature - 102°C

Operating temperature - 46°C

Power - W= 82.5 kw

Serves to supply the workshop with air

- Dryer  
Capacity – 8000l/min maximum

## **V II . PACKAGING AND LABELLING**

EUSIL F is packaged in porous, double-layer paper bags, labeled according to the requirements of European legislation.

Each package must have a label containing:

- Manufacturer - "MINERALCOMERS" AD
  - Name of food
  - List and quantity of ingredients
  - Net quantity
  - Expiration date
  - Name and address of the business entity
  - Country of origin
  - Instructions for use
  - Storage conditions

## **V III. STORAGE AND TRANSPORT**

The food additive EUSIL F - E551 should be stored in dry and ventilated areas in its original packaging, placed on wooden pallets and wrapped in foil for better protection. EUSIL F is stored in the company's warehouse until its expiration date.

The transport of the additive to customers is carried out using their own transport.

## **IX . Production control:**

• **Incoming control** of all raw materials and auxiliary materials is carried out daily, and all of them are accepted with the relevant analysis certificates, certifying their compliance with the requirements.

• **Control of production stages:**

1. Temperature – maintain the set temperature with permissible differences of 1-2°C
2. Water glass feed rate
3. CO<sub>2</sub> – the set CO<sub>2</sub> flow rate, while also monitoring its pressure after reduction (2.5 bar), pressure, temperature and level.
4. Air - the set air flow rate

5. pH – laboratory

6. OV – to monitor the level

● **Outgoing control** of the additive taken out of the warehouse is carried out by keeping records of which batch, what quantity and to whom they were sold. The goods leave the warehouse only in strong, well-sealed bags. If the integrity of the packaging is broken, the product is redirected to the rubber industry or handed over to a company as waste.

## **X. DOCUMENTATION**

Each batch of additive leaving the warehouse is accompanied by an analysis certificate certifying the readings of the controlled parameters for the respective batch, a warehouse receipt and an invoice. A sales register is kept, where all values from the invoice and the analysis certificate are entered.

In each department of the production process there is a journal in which the data of the monitored parameters is filled in by the dispatcher on duty as follows:

- Preparatory department
- Dispatch area
- Filtration area
- Finished product warehouse

When preparing the technical documentation, it was prepared according to the requirements of Regulation No. 14 /9.12.2021 on food hygiene

Label template:

|                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                |                                                             |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|-------------------------------------------------------------|
|  <b>MINERALCOMMERCE</b><br>6000 Stara Zagora, 1 Novozagorsko Shose Str., tel: +359 42 95 00 96<br>e-mail: <a href="mailto:mail@mineralcommerce.bg">mail@mineralcommerce.bg</a> ; <a href="http://www.mineralcommerce.bg">www.mineralcommerce.bg</a><br>BFSA reg. No. 24080044 |                                                                                                |                                                             |
| <b>EUSIL F</b><br><b>SiO<sub>2</sub> ≥96% E 551 - Food additive</b>                                                                                                                                                                                                                                                                                              |                                                                                                |                                                             |
| <b>Net weight: 20 kg ± 0.2 kg e Best by :</b>                                                                                                                                                                                                                                                                                                                    |                                                                                                |                                                             |
| Inhalation may cause respiratory irritation. No                                                                                                                                                                                                                                                                                                                  | <b>Content :</b> SiO <sub>2</sub> - 98.9%, Ca - 0.641%<br>Fe - 0.192%, Al - 0.165%, K - 0.122% | <b>Storage conditions:</b><br>In a dry and ventilated place |

adverse health effects are expected under normal industrial use.



For use as an anti-caking agent, carrier and thickener in foods and cosmetics.

Maximum amount in foods:

Flavorings - up to 20g/kg.

Dry powdered food - up to 10g/kg

**Batch No. :**

**Production date:**