



# What to know before buying a **PNEUMATIC DRYER**

Marcelo Precoppe



What you need to know before buying:

# PNEUMATIC DRYER

## 1. Pneumatic dryers

The most suitable type of equipment available for drying cassava is a pneumatic dryer, also known as a flash dryer. Pneumatic dryers are used to process cassava in many tropical countries. The high evaporation rate, and the consequent short drying time, provided by this type of dryer, allows using high air temperatures and achieving superior levels of energy efficiency, without overheating the material or jeopardising product quality. The main components of a pneumatic dryer are burner, heat exchanger, feeder, blower, drying duct and cyclone separator.

## 2. Burners

Burners are devices that burn fuel to produce heat. The heat generated by the combustion is used to warm the air via a heat exchanger. For small-scale cassava drying, diesel is the most common fuel type used. In pneumatic dryers, the burner should be thermostat-controlled, to allow the adjustment of the drying air temperature.

*Check before buying:*

- Do not buy a pneumatic dryer if the burner is not thermostatically-controlled.

## 3. Heat exchangers

Heat exchangers are devices that transfer heat from the combustion gases to the drying air. The fluids are separated by solid walls that prevent mixing. The efficiency of heat exchangers depends largely on the surface area between the two gases. Several types of heat exchangers are used in food processing, but the most common types are the double-pipe and the shell-and-tube heat exchangers.

Double-pipe heat exchangers are the simplest type and consist of two concentric pipes. They have a limited heat transfer surface and consequently lower efficiency. Shell-and-tube heat exchangers consist of a bundle of parallel tubes enclosed in a shell. This configuration allows a wide heat transfer surface and consequently offers higher efficiency.

*Check before buying:*

- Choose a dryer with a shell-and-tube heat exchanger instead of one with a double-pipe heat exchanger.

## 4. Feeders

Feeders are devices that introduce materials into the dryer at a controlled and specified rate. For pneumatic dryers, the feeder must promote good dispersion of the material in the airstream. Wet cassava grits are highly cohesive and can easily agglomerate into lumps, so for this reason, screw feeders are not recommended. Instead, a rotary valve feeder, also known as a star feeder, should be used. The rotary valve should have a hopper where the wall angles are 75° or steeper. All parts of the feeder that come in direct contact with the cassava grits should be made of food-grade stainless steel.

*Check before buying:*

- Do not buy a dryer that has a screw feeder.
- Do not buy a dryer if the walls of the feeder's hopper have an angle less steep than 75°.
- Do not buy a dryer if the parts of the feeder that come in direct contact with the cassava grits are not made of food-grade stainless steel.

## 5. Fans

In pneumatic drying, centrifugal fans are used to induce the air. They are usually driven by an electric motor using belts for power transmission. The fan can be installed at the beginning of the drying duct (positive-pressure conveying) or after the cyclone separator (negative-pressure conveying).

There are three main impeller designs available for centrifugal fans: forward-curved, backwards-curved and straight-blade. Straight-blade impellers are more robust, can support high-temperature and can tolerate particulate material in the airstream. For this reason, in dryers that are positive-pressured, the blower must use a straight-blade impeller.

*Check before buying:*

- ☑ In a dryer that uses a positive-pressure conveying system, do not buy it if the impeller of the centrifugal fan is not the straight-blade type.
- ☑ Do not buy a dryer if the parts of the fan that come into direct contact with the cassava grits are not made of food-grade stainless steel.
- ☑ Do not buy a dryer if the belt's drive components are not enclosed under a safety guard.

## 6. Drying duct

The drying duct is where the wet solid is dried. The heated airstream is responsible for both transporting and drying the solid. The drying duct must have enough length to provide the time needed to achieve the desired moisture content. A drying duct of incorrect length results in low energy efficiency. The Drying duct should be enclosed with thermal insulation, and all parts that come into direct contact with the cassava grits should be made of food-grade stainless steel.

*Check before buying:*

- ☑ Do not buy a pneumatic dryer, if the length of the drying duct diverges significantly from the length calculated using the [cassavatech.com](http://cassavatech.com) drying-duct-designer.
- ☑ Do not buy a pneumatic dryer if the drying duct is not thermally insulated.
- ☑ Do not buy a pneumatic dryer if the parts of the drying duct that come into direct contact with the cassava grits are not made of food-grade stainless steel.

## 7. Cyclones

Cyclones are devices that separate particulate material from the airstream using centrifugal sedimentation. Cyclones are present in diverse industrial processes and in pneumatic dryers they are used to separate the material from the drying air. The dried grits are collected at the bottom of the cyclone and the air exits from the top. This air may still contain small-sized particles and a second cyclone can help to separate them further. Two cyclones in series are most common, but sometimes three cyclones in series are used.

There are several standard cyclone designs and its dimensions are determined by the air flow rate. For large air flow rates, the resulting cyclone may be so large that the centrifugal force generated is low, reducing collection efficiency. A possible solution would be to split the air flow into smaller cyclones operating in parallel. In theory, smaller diameter cyclones have higher centrifugal forces, resulting in better collection efficiency. However, when replacing a large cyclone with many smaller ones, arranged in parallel, it is necessary to ensure that the airflow is equally distributed to each one. Equalizing the air flow rates into each cyclone is difficult and, in practice rarely achieved. If air is not distributed equally to each cyclone, collection efficiency reduces significantly, operating worse than a single large cyclone. Therefore, cyclones in parallel should only be used when is not possible to fit a single large cyclone into the available height, or when extremely high centrifugal forces are required. Use the [cassavatech.com](http://cassavatech.com) cyclone-designer to verify if the manufacturer has dimensioned the cyclone correctly.

*Check before buying:*

- ☑ Do not buy a pneumatic dryer that uses a cyclone that does not follow one of the standard designs.
- ☑ Avoid buying a dryer that uses cyclones in parallel.
- ☑ Do not buy a dryer if the parts of the cyclone that come into direct contact with the cassava grits are not made of food-grade stainless steel.

## 8. Performance indices

Several energy efficiency indices are used to measure the energy performance of pneumatic dryers, but the *specific energy consumption* is the most common one. It is defined as the *heat input to the dryer* per unit mass of water evaporated and is normally expressed in megajoules per kilogram of water (MJ/kg<sub>water</sub>). However, the definition of *heat input to the dryer* can vary. Some calculate it based on fuel consumption while others are based on the temperature, humidity, pressure and flow rate of the air at the beginning of the drying duct. Furthermore, to compare between different dryers' *specific energy consumptions*, and other energy performance indices, the conditions at which the tests were performed must be very close, particularly the initial and final moisture content of the cassava grits. For those reasons, benchmarks and ranges for energy performance indices have not yet been determined.