

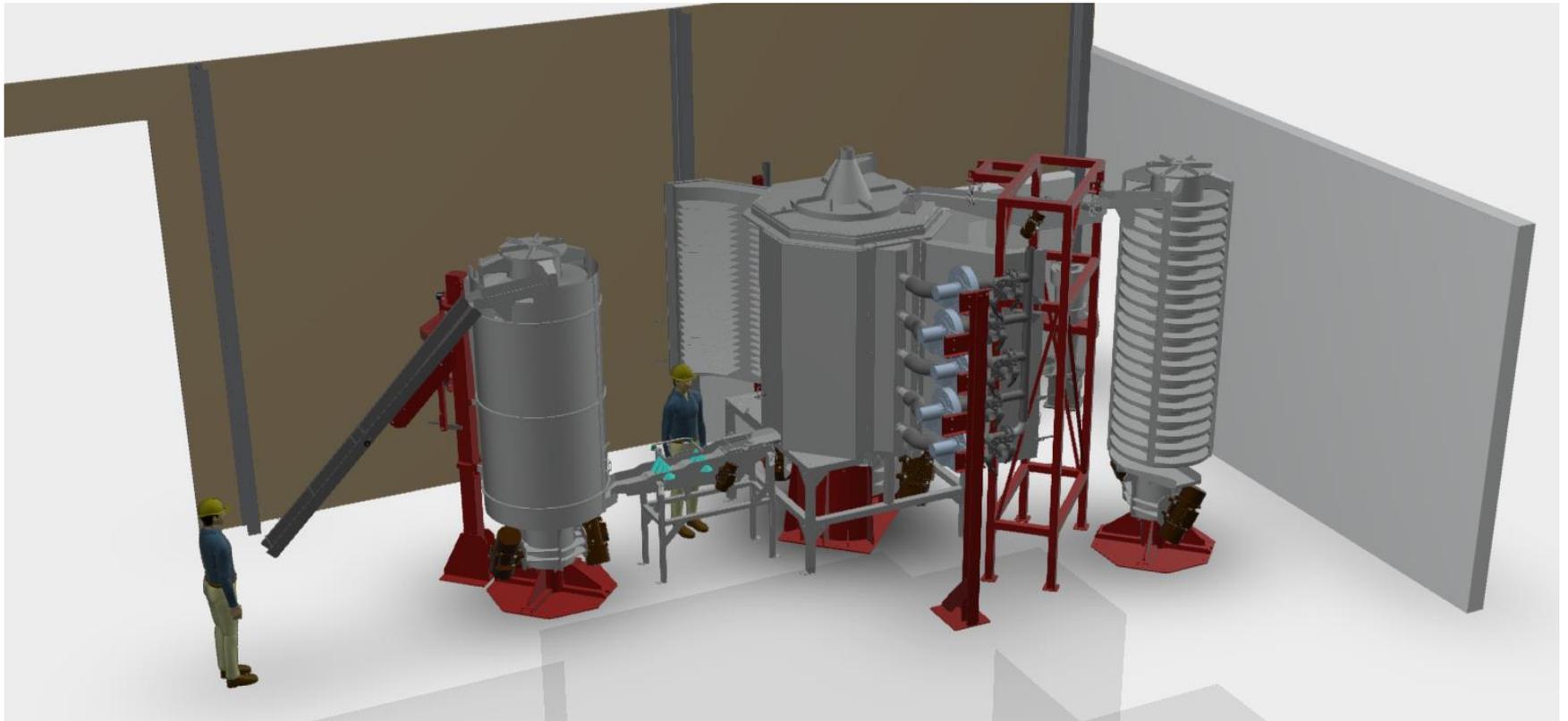
Roasting solutions

A new roasting philosophy





ROASTINSTEP



Key figures

Roastinstep market

Peanuts (43 million tons per year)

Malts (21 million tons per year = 634 kg per second)

Coffee (9,18 million tons per year – 235kg per SECOND)

Cashew (6 million tons per year)

Cocoa (5,25 million tons per year)

Sesame (2,28 million tons per year)

Almonds (1,2 million tons per year)

Pistachios (1,4 million tons)

Hazelnuts (1 million tons per year)

Macadamia (60 000 tons per year)





Key figures & market insight

- 2019 : a big player in roasters sold for 112 Million € of roasters (68 units)
- 2000 roasters sold in the world each year
- CO₂ emissions, sustainability becomes a priority , a « green » process will soon be a need for the planet



Existing technologies

- Batch roasters
 - rotating paddles product is not in mass
 - rotating chamber product is in mass
- Continuous roasters
 - Heating only by contact
 - Heating by air only
 - ALL THESE ROASTERS ARE **DRY ROASTERS**
 - The steam generated by product is blown away

Roastinstep combines heating by air and by contact

Moreover in Roastinstep the steam generated by product, full of aroma is use to pre heat the incoming product and keeps all aroma into the product.



Existing technologies

Batch roaster

▶ BATCH system

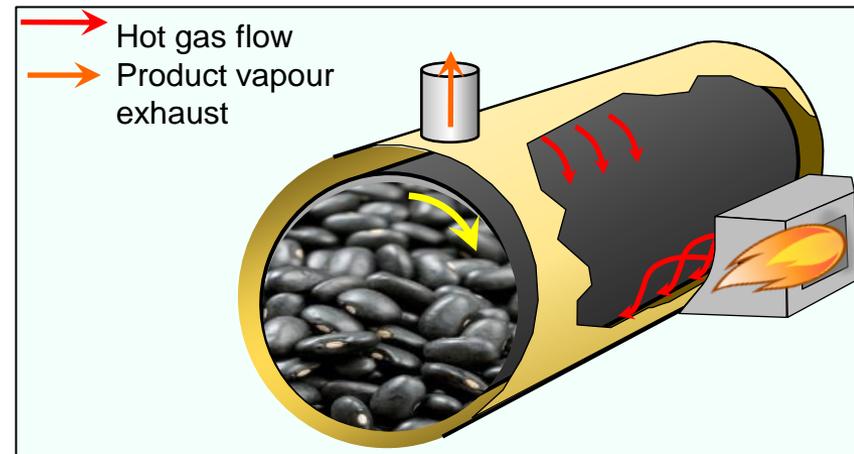
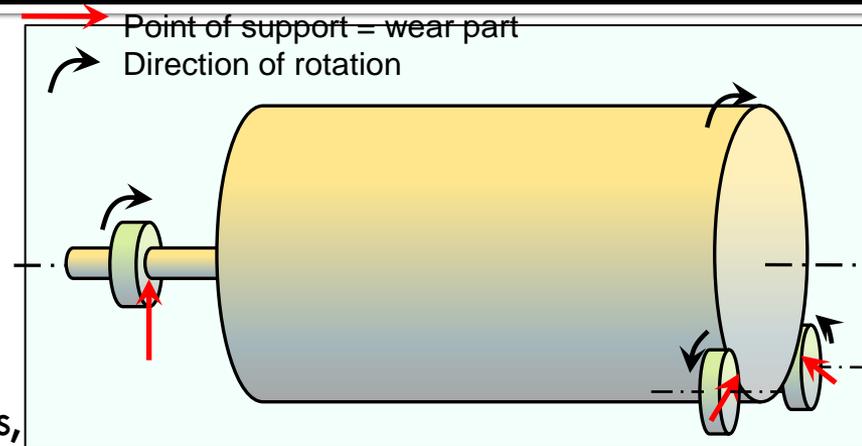
- ▶ Used for all particles sizes

▶ Advantages :

most common on the market,
flexible technology: able to treat wet products,
high quality of treated product,
filling ratio: 70% (aroma development),
System easy to set-up

▶ Limits :

batch = high operating costs,
many moving wear parts,
energy efficiency $\approx 60\%$ (energy used to heat the product is blown away)
Product is in mass



electrical consumption (based on a 5t/h unit) \approx **280 kWh/t**



Existing technologies

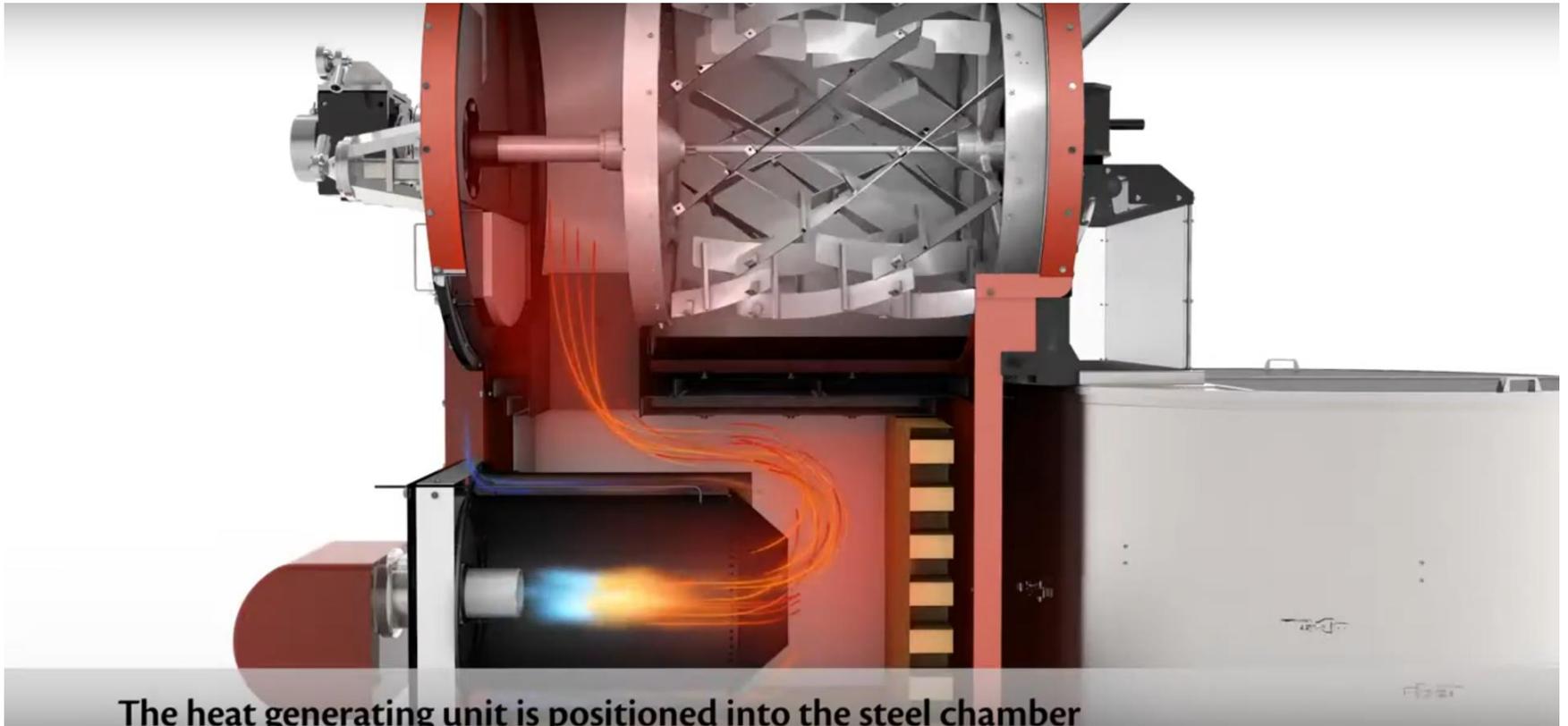
Batch Roaster





Existing technologies

drum roaster rotating paddles



The heat generating unit is positioned into the steel chamber



Existing technologies

Batch roaster

Rotating chamber heating by contact (gaz powered)





Existing technologies

Vertical roaster heating by air

▶ CONTINUOUS system

- ▶ Technology based on the hot air injection
Can only be used with whole products and kernels

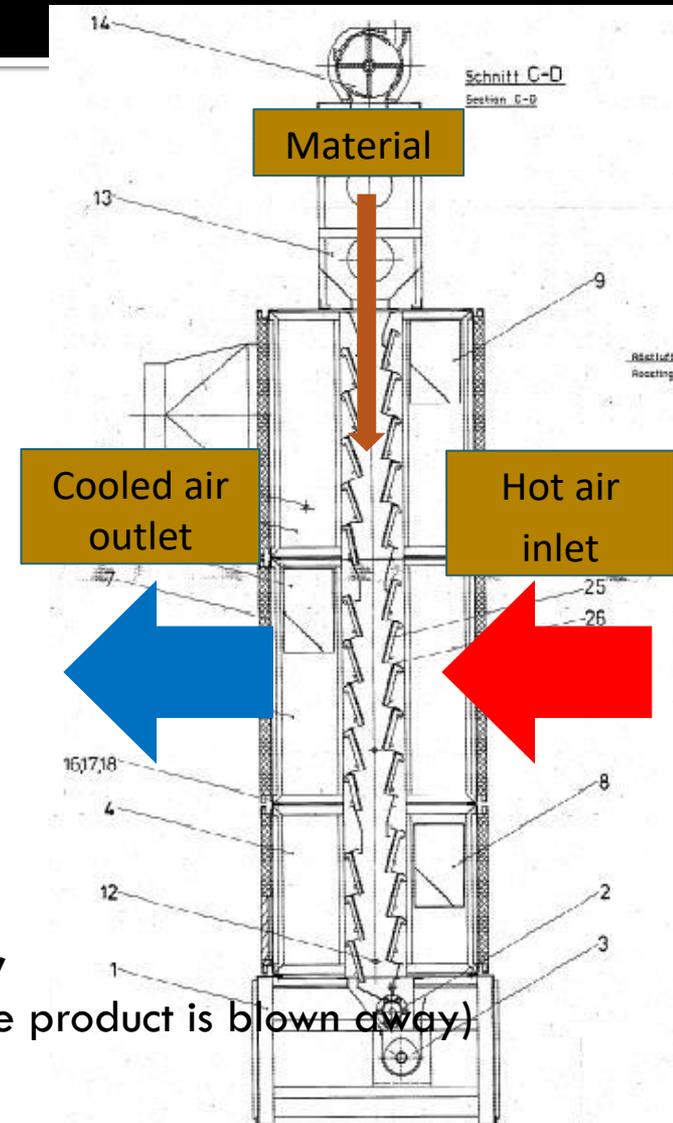
▶ Advantages :

continuous process = low operating cost,
no moving part,

▶ Limits :

large and voluminous installation,
impossible to treat humid products and small particles,
low energy efficiency $\approx 50\%$ (energy used to heat the product is blown away)
product is in mass

electrical consumption (based on a 5t/h unit) \approx **350 kWh/ton**





Existing technologies

Spiral roaster heating by contact

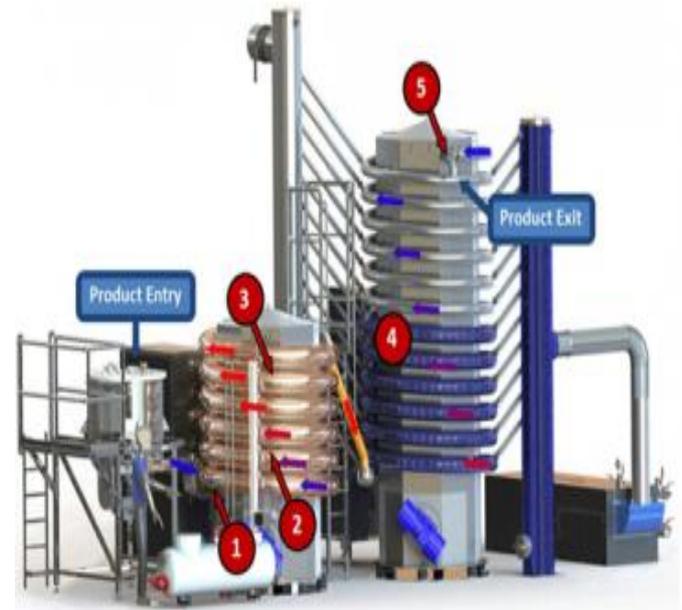
1. Product is fed through spiral tube
2. Product is heated by direct contact with hot tube going up by vibration
3. Product is cooled down by the second spiral tower

Advantages:

- Transport by vibration, no damage to particles
- Electricity: no CO₂ emissions

Limits:

- Minimum of quantity is 250 KG, no small lots
- Can only feed the tube to 1/3
- Impossible to guarantee the inside is clean
- Uneven mixing drives to uneven roasting
- Roasts only by conduction (by contact)
- No air flow control
- 150kWh/ton electrical consumption (roasting)
- The steam generated by product goes out by chelney effect and is slowing down the process as it goes up into the process.



Existing technologies

Belt roaster continuous roaster heating by air

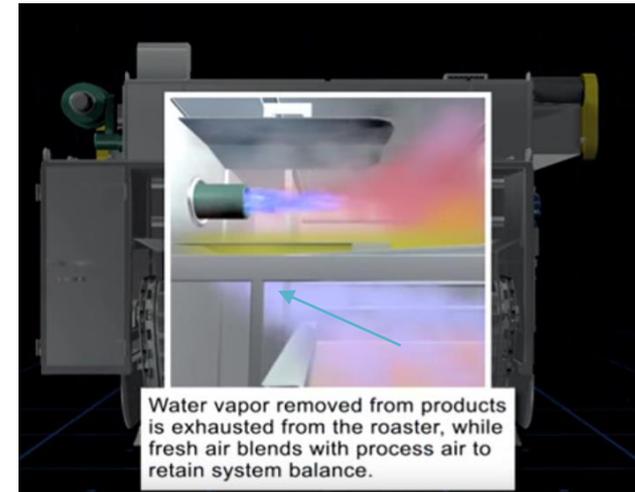
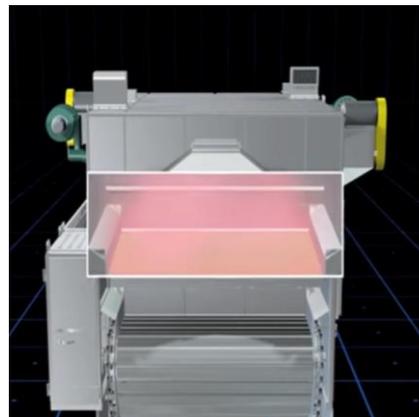
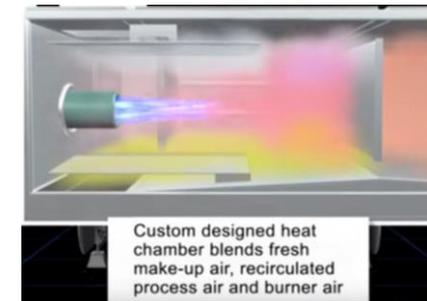
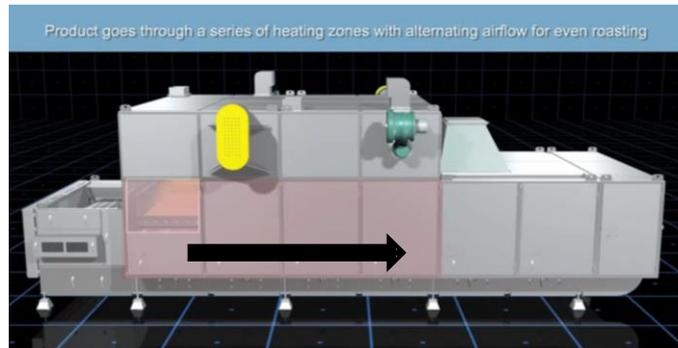
Product is fed on a belt conveyor for transportation, hot air roasts the product

Advantages:

- Transport by belt no damage to particles
- Product is on a thin layer
- Commonly used for nuts

Limits:

- Uneven mixing leads to not even roasting
- Steam is removed which is saving at middle and end of process but losses at beginning of process. (no better way than steam to pre-heat product when cold)
- Roasts only by air
- 250kWh/ton
- CO₂ emissions
- Huge airflow
Means big loss of aroma and flavor.





Systems developed by FCD



FCD's first generation roasters





TSB100

A small batch roaster





TS Roaster

continuous roaster





AND NOW

2022 Roastinstep[®] is born

→ Preserves taste, protects the planet



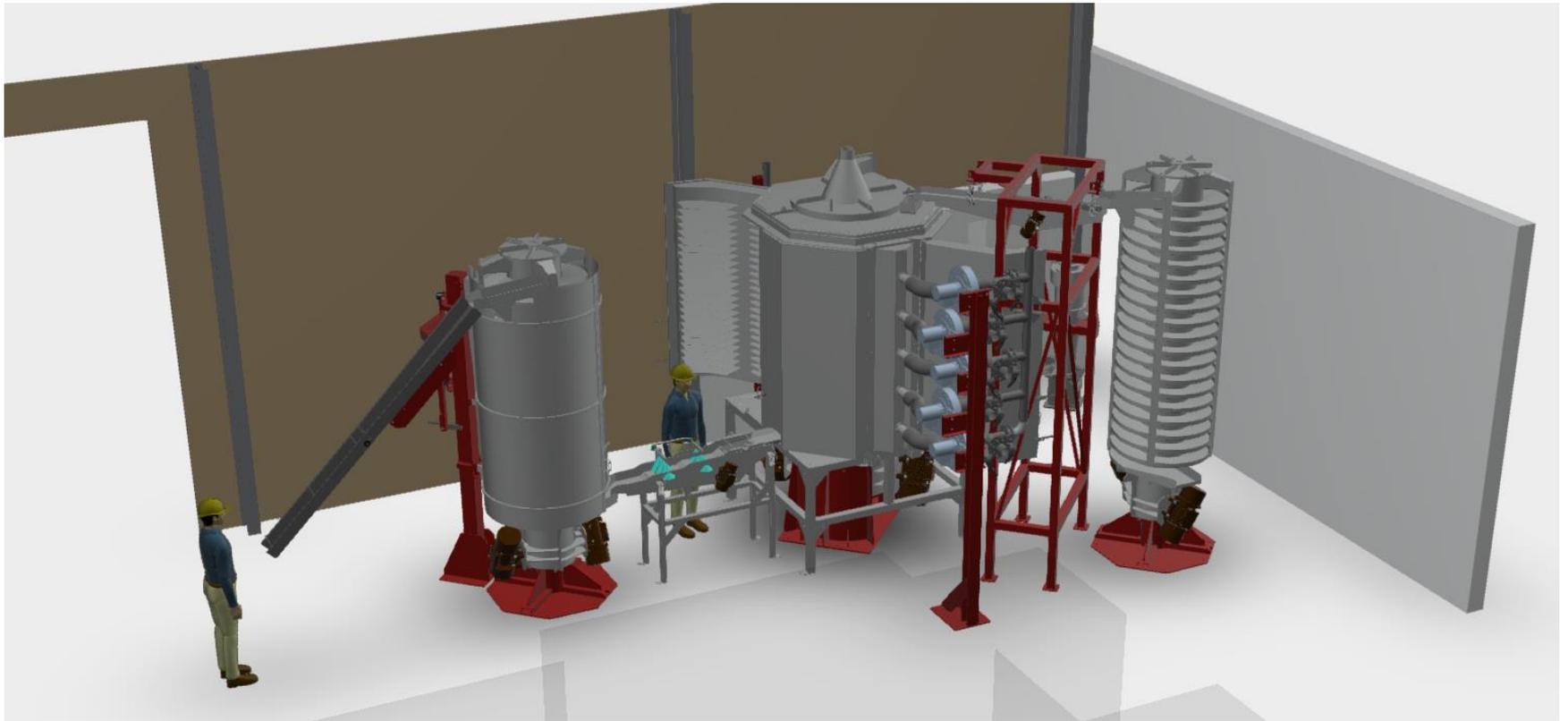


All roasters presented show the technical issues to solve:

- Big losses of energy
 - Air heated must be re used and not thrown away
- heating by gaz that creates CO2
 - Use electrical resistances
- a big mass of product is difficult to heat (or cool) evenly, long and very energy consuming
 - Use thin layer distributed by vibrations
- Ratio air to product is key point to control flavors and aroma, so air flow control is necessary
 - Use a perfect control on air flow and temperature of air injected at each zone independently
- Some products need specific temperature profiles
 - Use zones with specific heating systems and specific air flow control.
- Particles must be treated evenly , on all surfaces, without breakes or splittings.
 - Use a step system to mix with small fall between steps
- steam generated during first stages of roasting ate usually thrown away, aroma and flavors from these steps is blown away as well as all heat, it's huge loss of energy (from 20 to 100°C is at least 50% of heat).
 - Use a vertical spiral system where product goes down whereas steam goes up and re use the steam

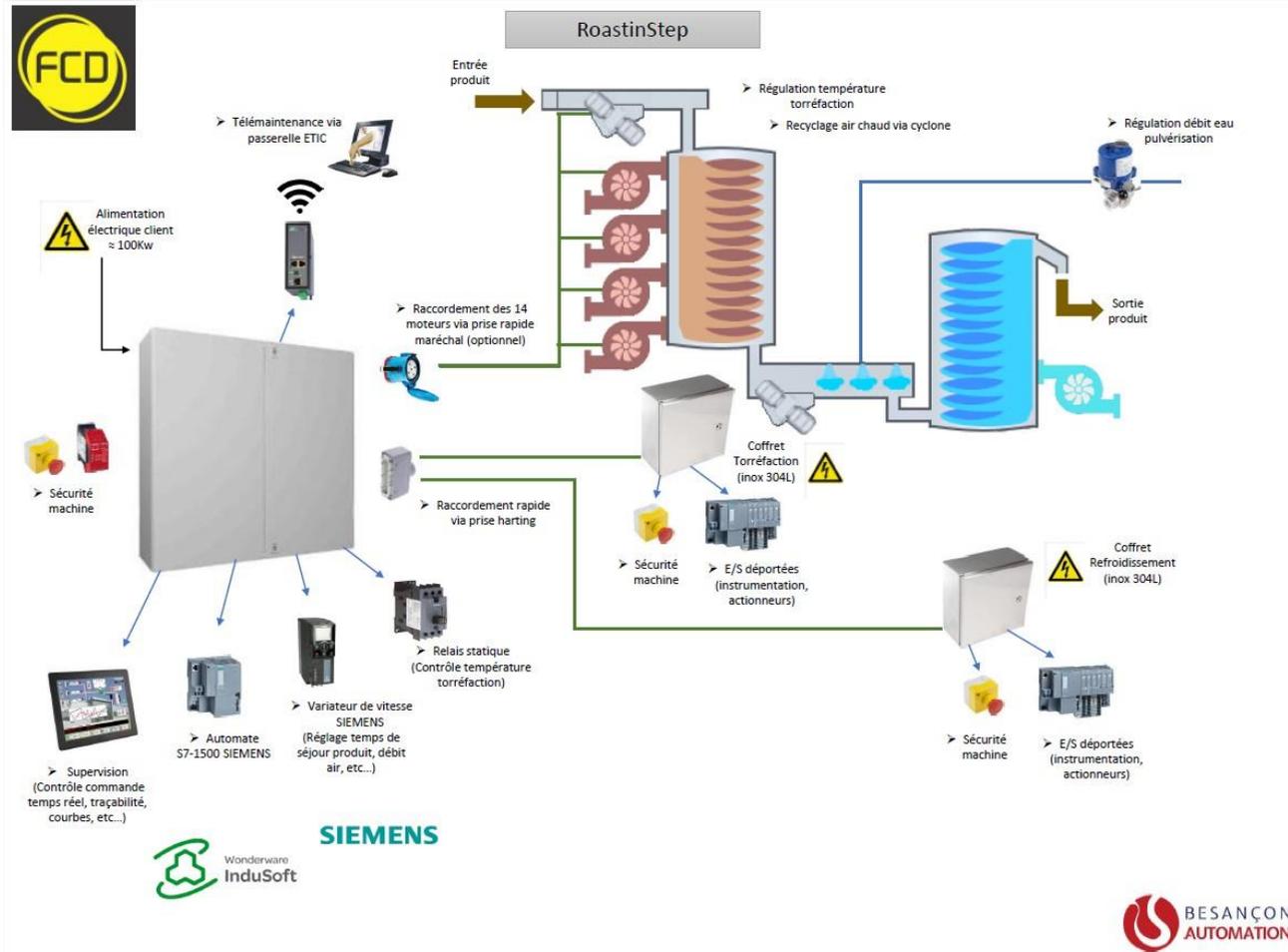


ROASTINSTEP





Process diagram





ROASTINSTEP process présentation

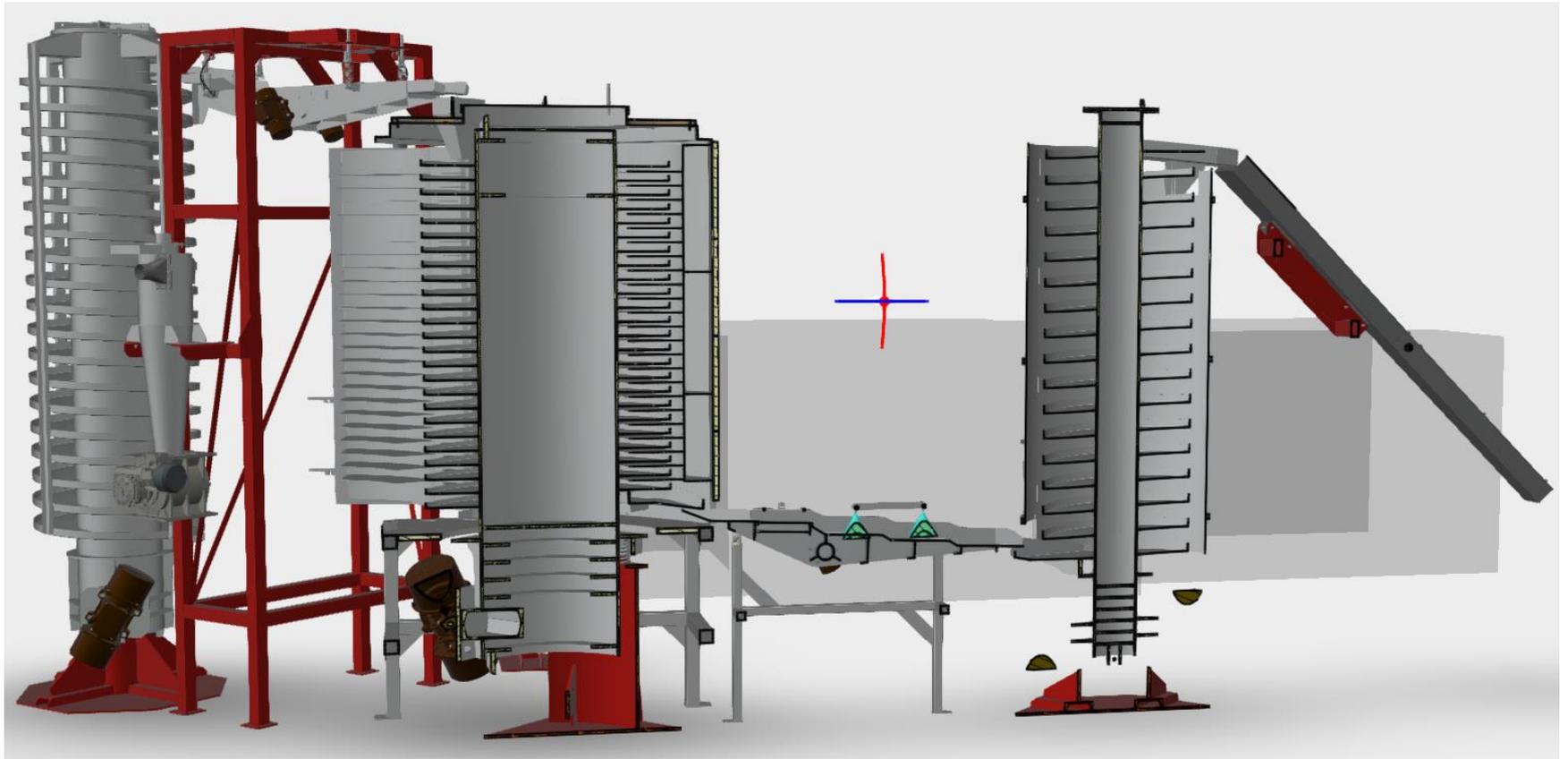
- The process consists in a transport by vibration on an horizontal ring. At the end of the ring the product falls by gravity to the next step on the lower ring. This succession of steps ensures a perfect mix.
- There are more than 20 steps, the diameter , height of roaster and width of rings are adjustable in order to match the required capacity.
- The bed thickness will never change in order to garantee the homogeneity and eveness of treatment.
- The hot air is injected on one side of the roaster by different electrical resistances coupled with fans. This system allows to have different seperated zones and ensures a perfect control of air temperature profile and air flow to develop flavors and aroma.
- Of course it is possible to adjust on each fan the air flow and air temperature independantly.
- On the over side of the roaster a precise system of extraction of air allows to control the flow inside each zone.
- The hot air extracted goes to a cyclone to remove dust, products skins, fines. And is then blown again in system in order to have great energy savings.
- There's of course the possibility to use and blend it with fresh air in case of need.



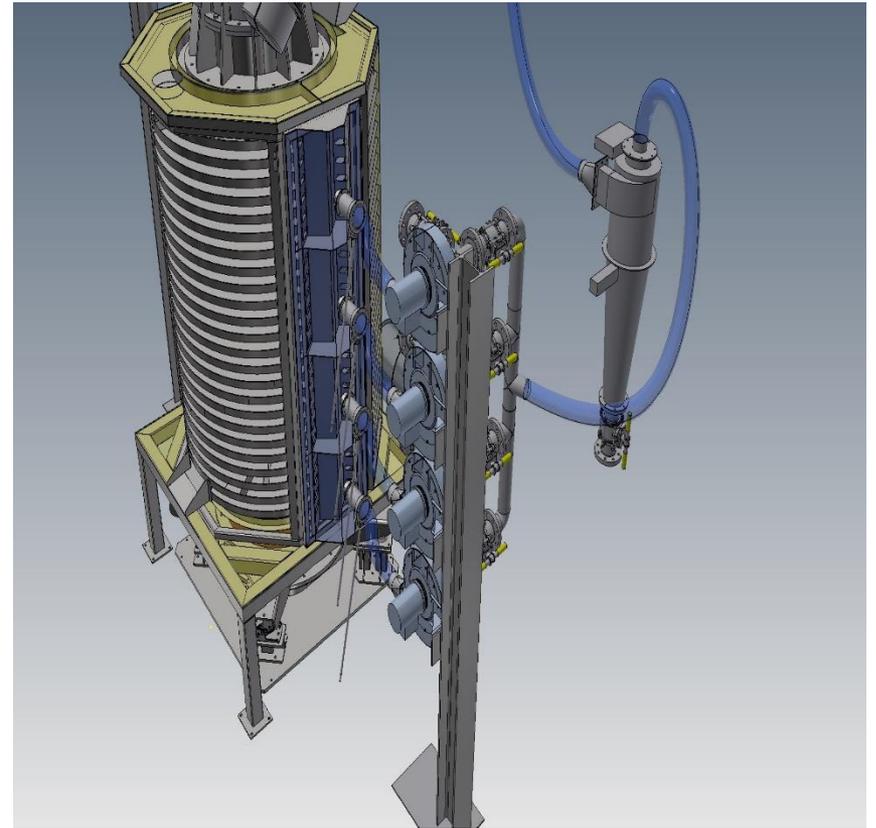
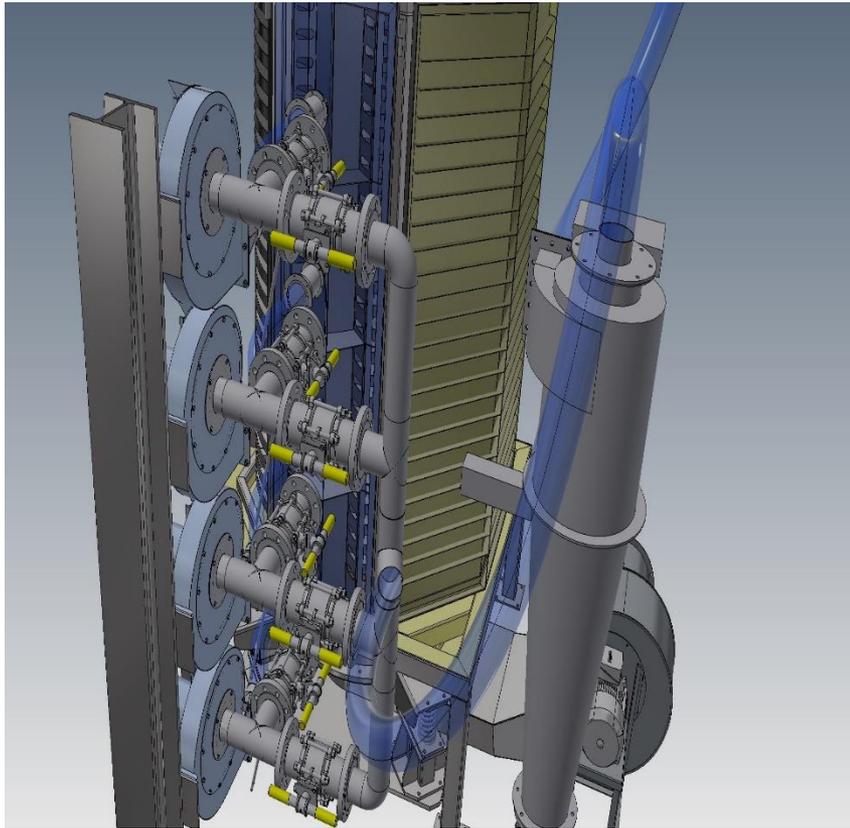
SUSTAINABILITY

- **ROASTINSTEP is heating by air and contact the product , origin is electricity ONLY**
- no CO₂ emissions from a gaz
- complete GREEN roaster
- The re use of hot air ensures a **40% energy saving**

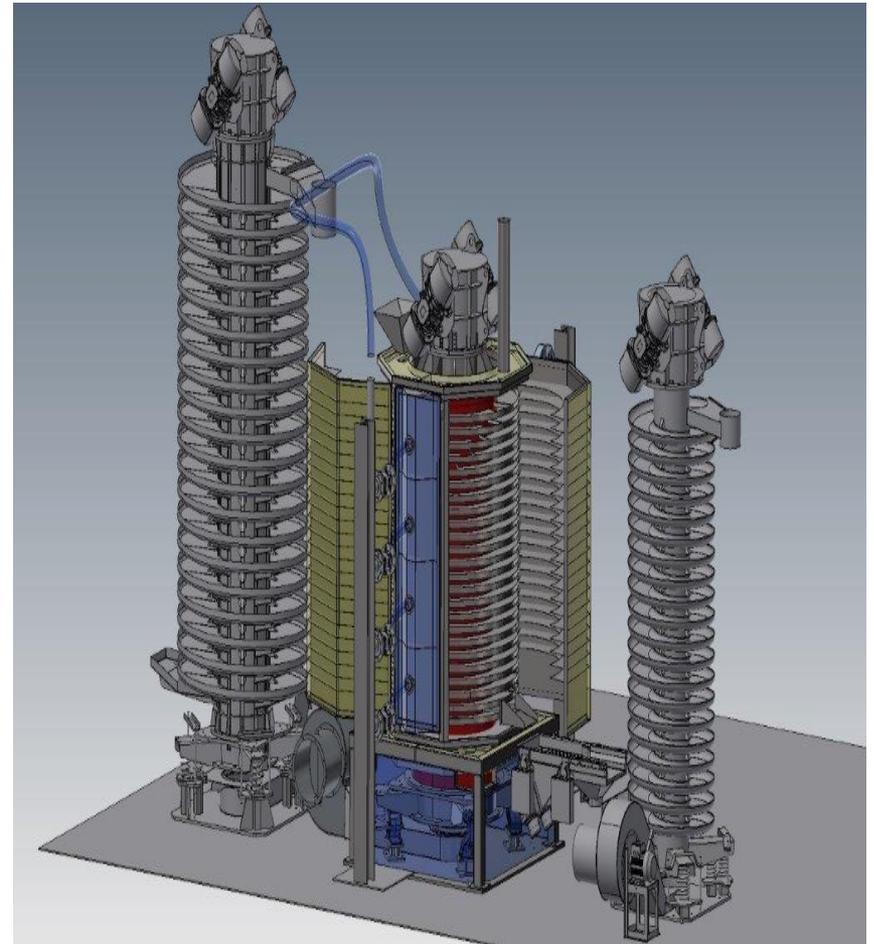
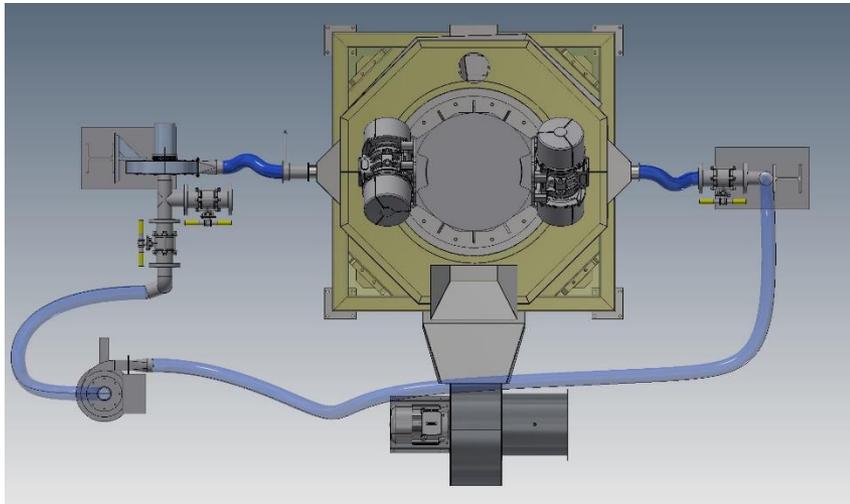
ROASTINGSTEP



ROASTINGSTEP



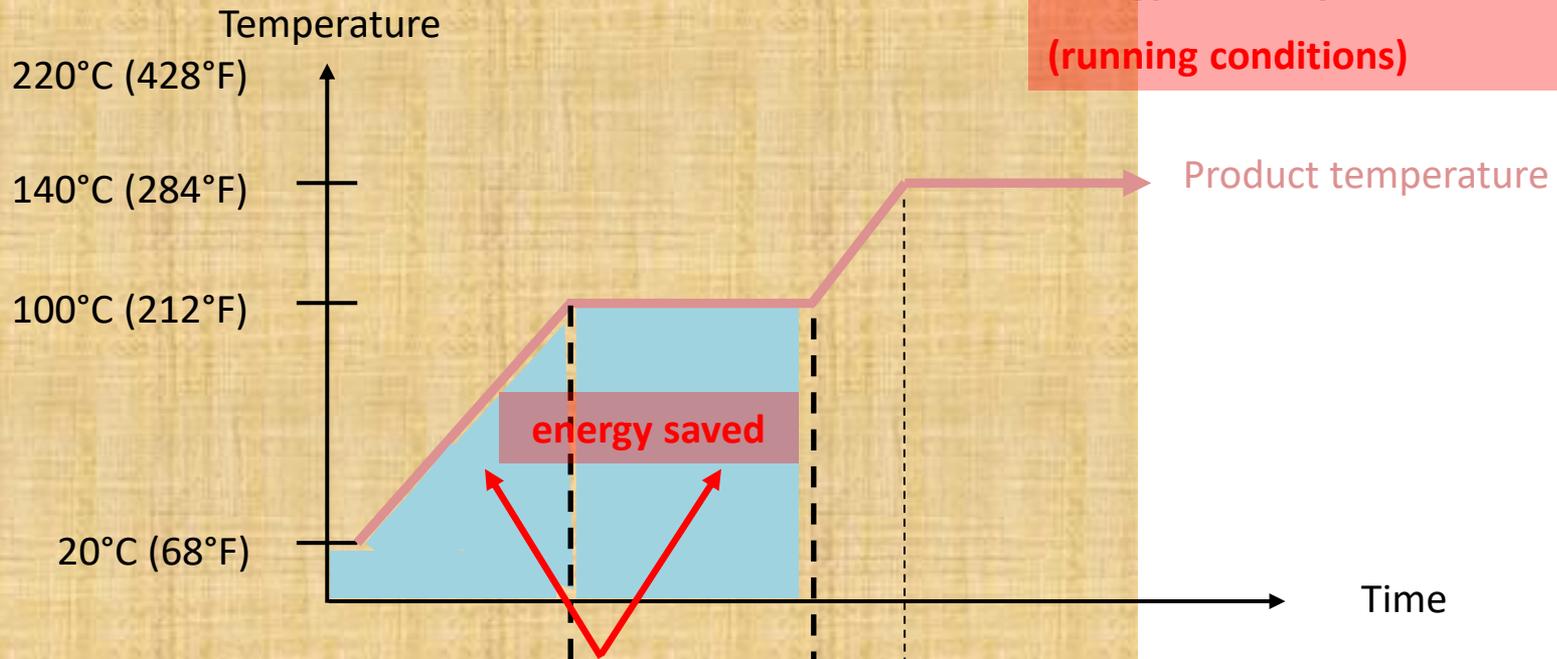
ROASTING STEP





How was born Roastinstep[®] ?

Why is the Roastinstep so energy efficient ?





Roastinstep: Main features

Possibility to roast all sorts of ingredients	YES	Cashews, almonds, coffee with thin bed and vibration
Possibility to treat small lots ?	YES	
Homogeneity of the treatment ?	YES	Steps ensure the mixing, thin product bed
Easy, quick and accessible cleaning ?	YES	<1hrs, doors for quick access
Low energy cost ?	YES	<70 kWh/ton, thin product bed
Low maintenance cost ?	YES	< \$1000/year (vibrating system)
Eco friendly process (CO ₂ emissions	YES	



Roastinstep main benefits

- ▶ a continuous roasting process patented by FCD
- ▶ the synthesis of the advantages of existing roasting technologies:
thin layer – continuous process – flavor and aroma control - energy savings
- ▶ “RoastinStep” ANSWERS TWO STRATEGIC ELEMENTS:

The reduction of the COSTS

HOW ?

- By reducing the energy costs by minimum 40% compared to other technologies
- By reducing the maintenance costs/ year
- By using a continuous process
(= low labor cost) & lower line investment
(less buffer silos)

The control of the QUALITY

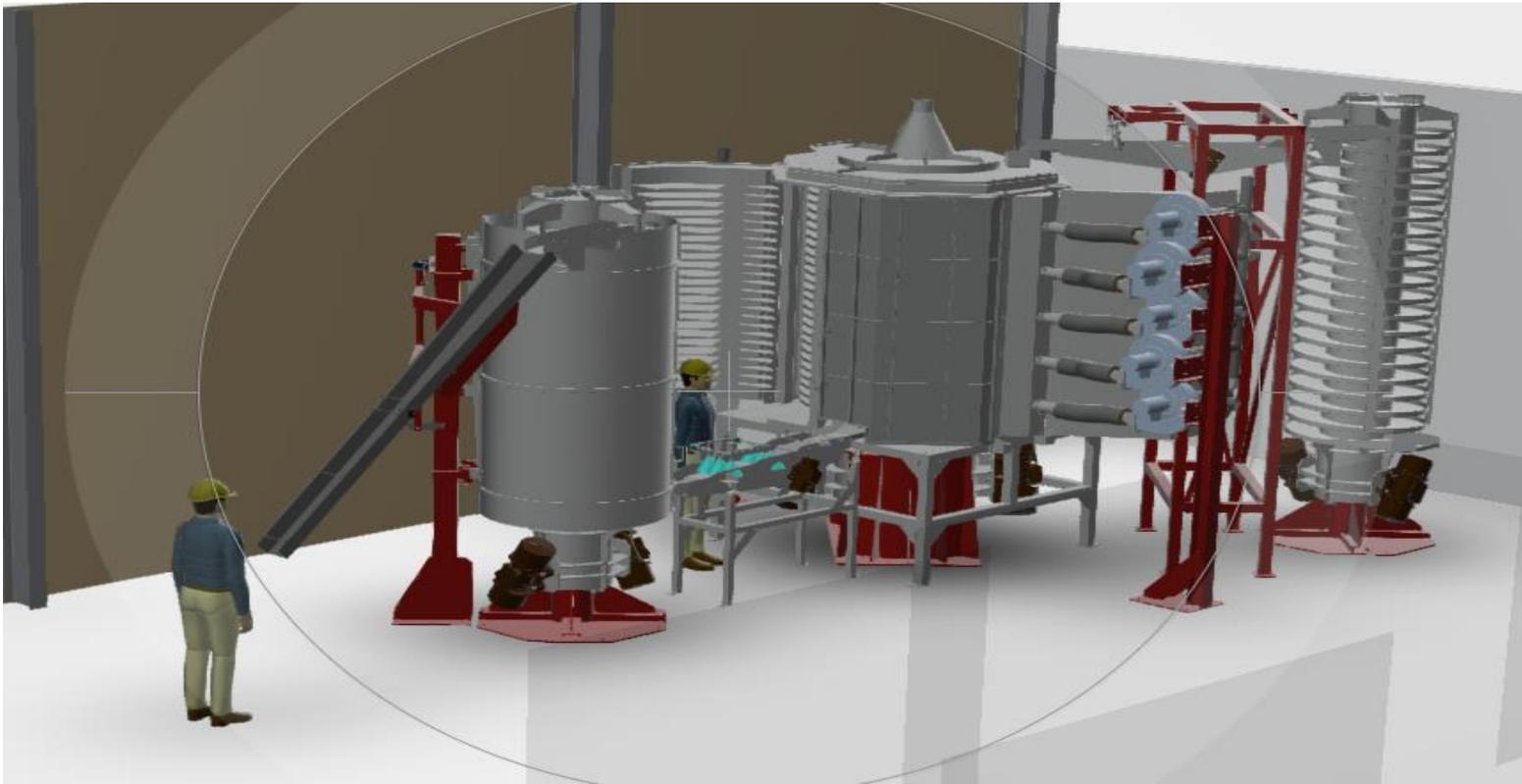
HOW ?

- By permanently mixing the product
= control of the temperature gradient
= homogenization of the treatment
- By controlling the air flow and air temperature
in each zone
- By controlling the residence time on roasting
AND cooling



Roastinstep by FCD

Roastinstep summary





- ▶ Transport by vibration for no damage to particles
- ▶ Heat by contact **and** by air
- ▶ Re use of steam coming from previous product to save energy
- ▶ Re use of hot air to save energy

electrical consumption \approx 70 kWh/t



Roastinstep versus competing technologies

Kind of roaster	Heating by air	Heating by contact	Treat in mass	Treat in thin layer	Possible to treat fragile products (cashew peanuts..)	Possible to control air flow	Possible to use steam generated by product to pre heat product	Possible to treat coffee and cocoa	Air temperature profile possible	Energy consumption in KWH/T	CO2 emissions	GREEN PROCESSES	Price for a 1T/H line in euro
Rotative gaz roaster	no	yes	yes	no	no	yes	No	Yes	Yes	280	Yes	no	750 000
Drum roaster	yes	yes	yes	no	no	yes	no	yes	yes	250	yes	no	
Spiral roaster	no	yes	no	yes	yes	no	no	no	no	150	no	yes	754 000
Vertical air roaster	yes	no	yes	no	no	no	no	yes	yes	350	yes	no	
Belt roaster	Yes	No	No	Yes	Yes	No	No	No	No	130	Yes	No	
FCD TS roaster	Yes	Yes	Yes	No	No	No	Yes	Yes	No	110	No	yes	650 000
FCD roastinstep roaster	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	70	no	yes	750 000