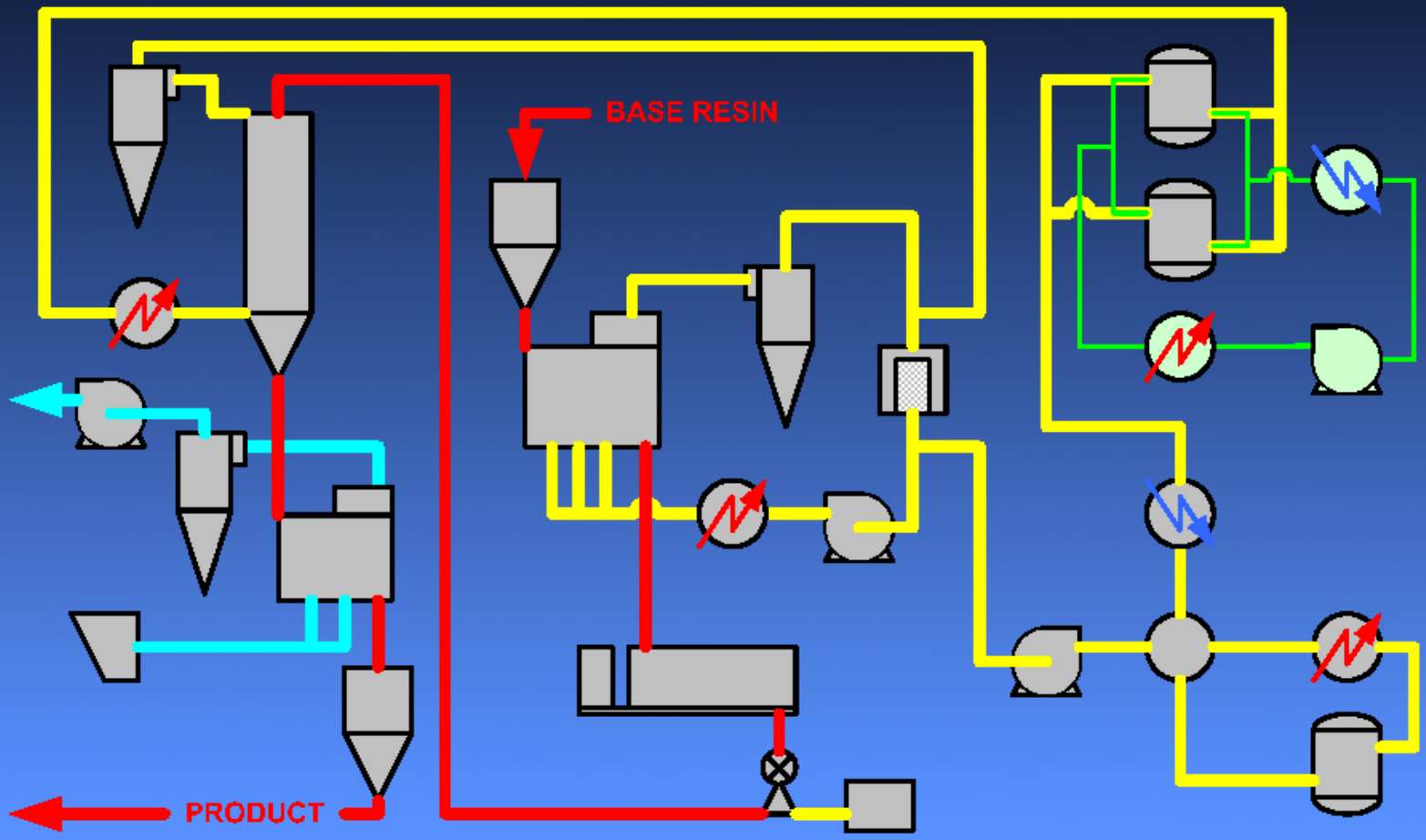
SSP Introduction

A Honeywell Company

SSP Plant (Solid State Polymerization)



SSP Introduction

A Honeywell Company

1 Precrystallizzation

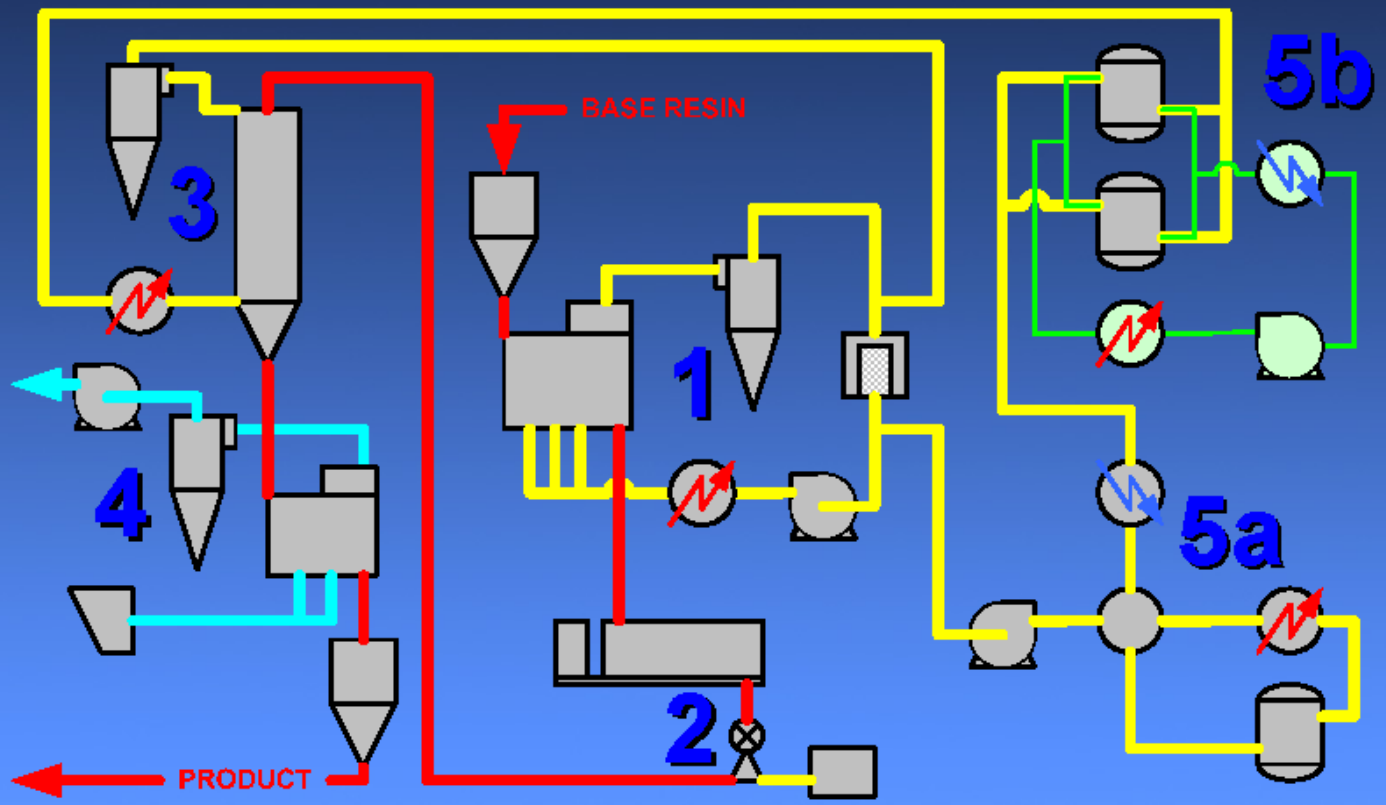
2 Crystallizzation

3 Solid State Po

4 Chips cooling

5a NPU Oxidation

5b NPU Essicazione & Rigenerazione



Property	Unit	Value/Range
Intrinsic Viscosity	dl/gr	0.84 + 0.015
Intrinsic viscosity lift	dl/gr	0.24
Carboxylic end groups		Lower than base resin
Acetaldehyde Content	mg/kg	0.7 max
Chips temperature	°C	60 max
Color (b*)	CIE LAB	<0
Dust (fines)	Wppm	<50

Property	Unit	Value/Range
Intrinsic viscosity	dl/g	0.60 + 0.005
IPA + DEG modification level	Wt%	3.5 ± 0.5 max (DEG 2.0 % max)
Sb Content	ppm	>240
P Content (suggested)	ppm	30
Co Content (suggested)	ppm	35
Color b*		-1 ± 0.5
Carboxyl End Group		40 ±3
Acetaldehyde content	mg/kg	60 average 100 max
Moisture content	Wt%	0.4 max
Fines	ppm	300 max

UTILITY	UNITS	Expected
Electrical Power	KWh/ton	55
HTM Energy	KWh/ton	85
Cooling Water (25 °C), At = 7 °C	m^3/ton	6.5
Instrument air	Nm^3/ton	5
Nitrogen	Nm^3/ton	6

PRECRYSTALLIZATION

The section is composed by :

1)Unloading silo

2)Inlet rotary valve

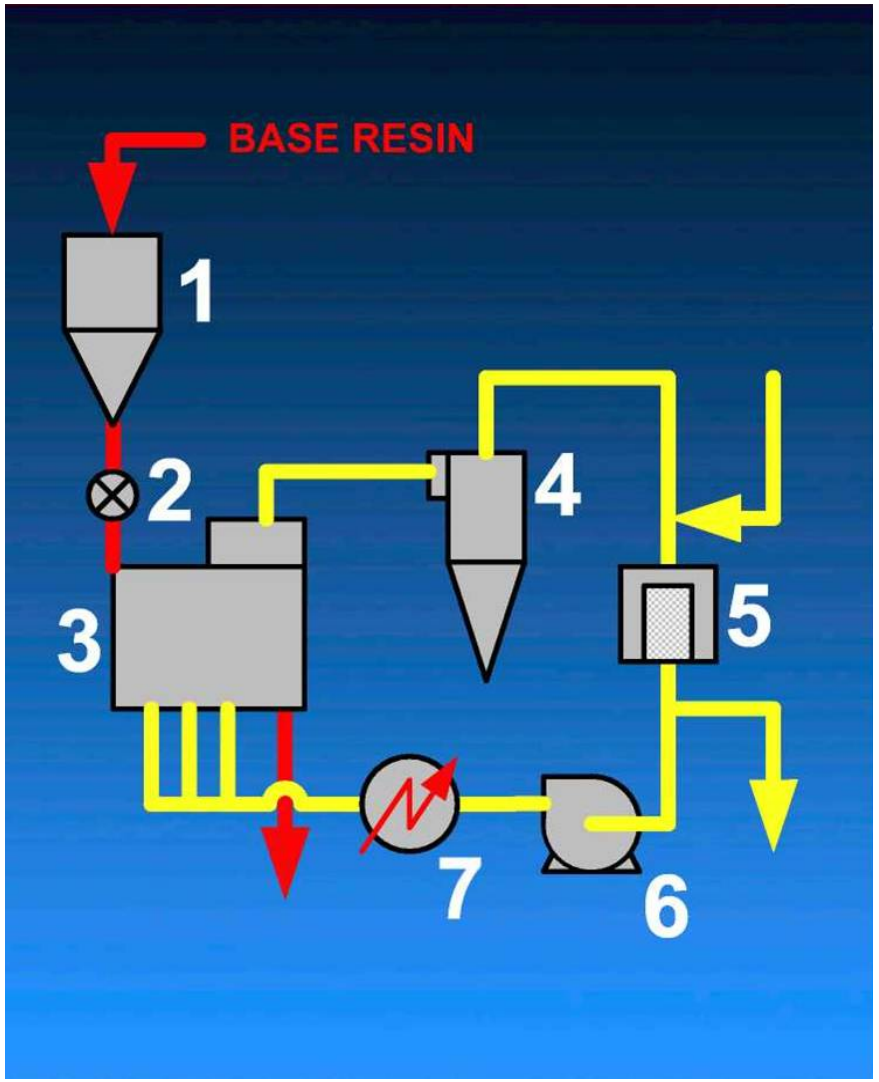
3)Precrystallizer

4)Cyclone

5)Filter

6)Blower

7)Heater



PRECRYSTALLIZATION

Targets:

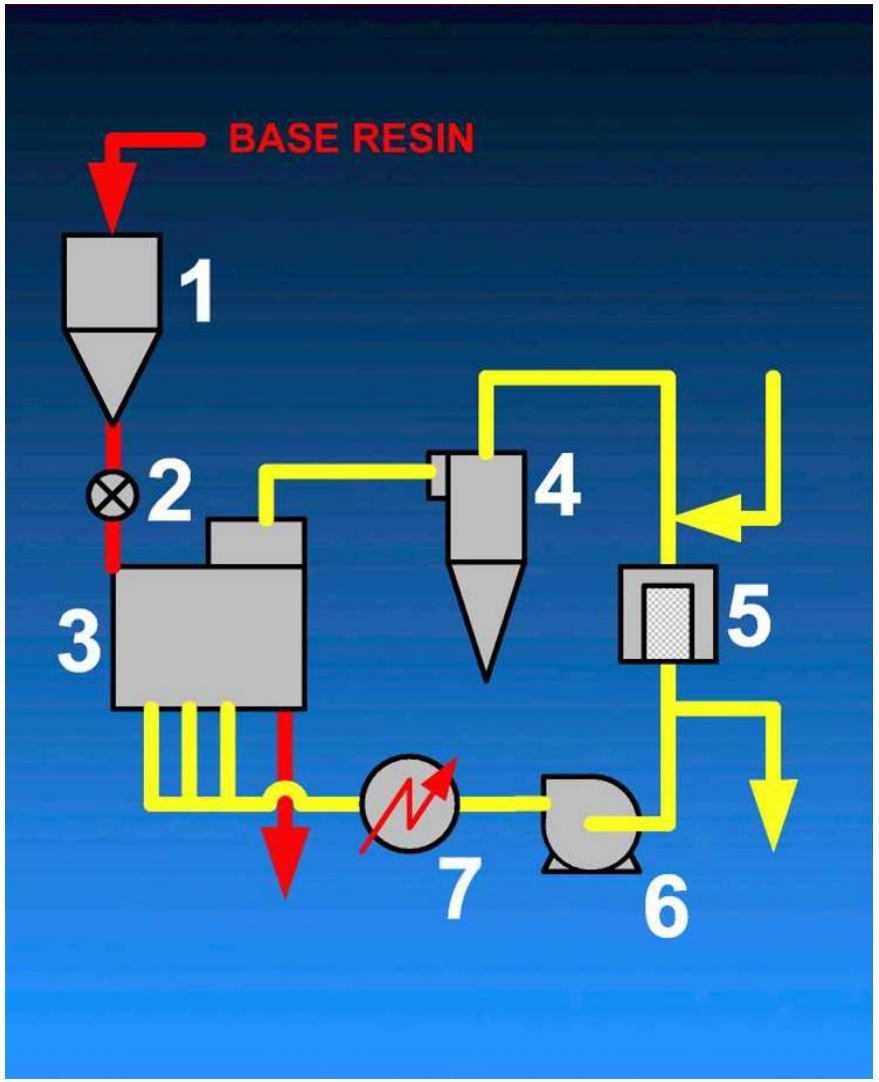
1)Primary crystallization

2)Dust removal

3)To evaporate water from chips

4)To reduce the acetaldehyde

5)To increase the temperature of chips from 185 to 195 °C



PRECRYSTALLIZATION

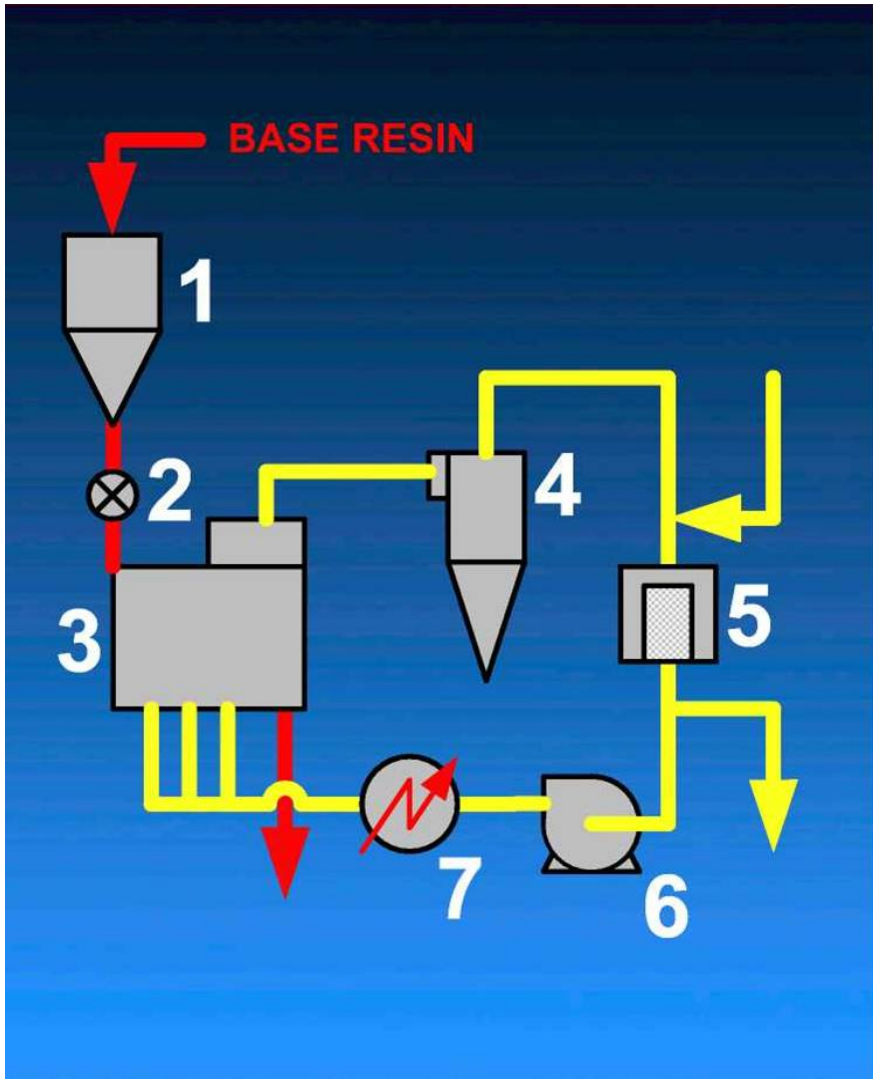
Working principles:

1)The blower (6) guarantees the nitrogen flow in order to win the pressure drop and to heat the polymer up to 185-195°C

2)The heater (7) increases the temperature of nitrogen at about 220 °C

-The precrystallizer (3) fluidizes the chips in three adjacent rooms falling down from silo through the rotary valve (2)

3)The cyclone (4) removes dust from gas coming out from precrystallizer



PRECRYSTALLIZATION

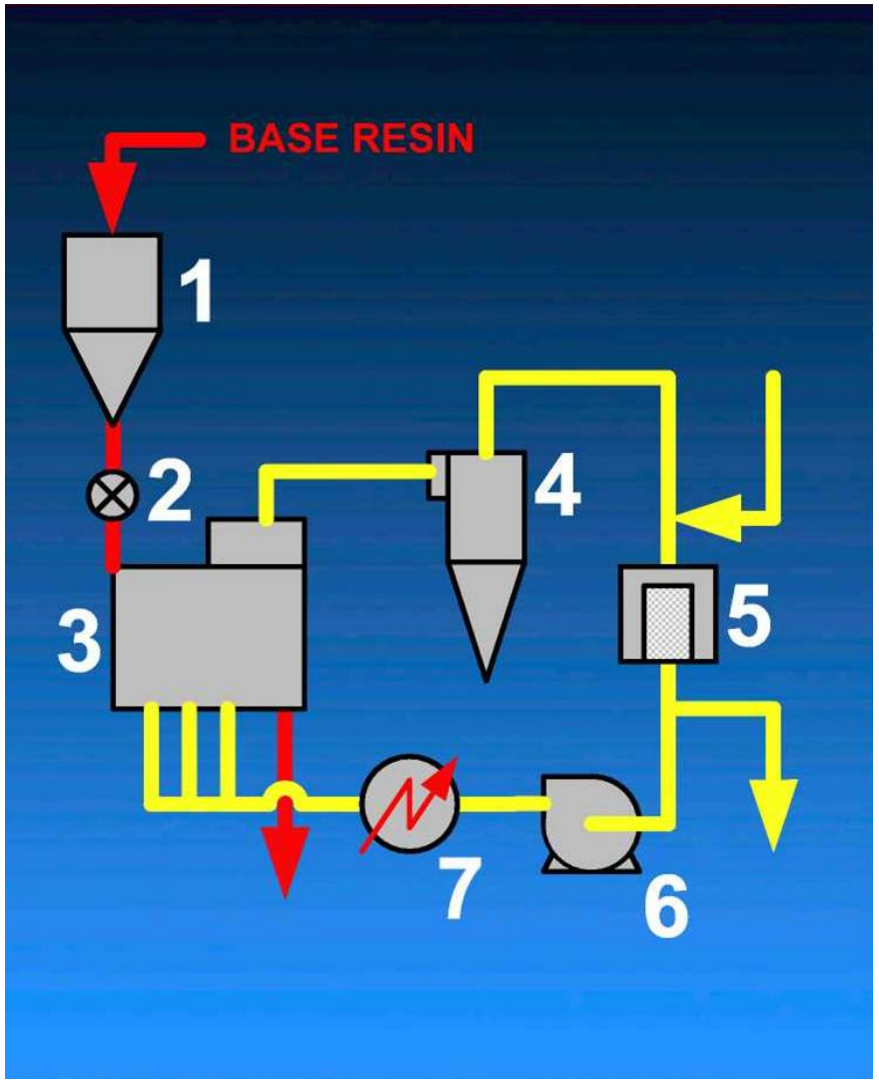
Working principles:

4)The filter (5) protects the blower and the heater from dust not collected by cyclone

5)A stream of nitrogen (about 5%) with VOC and water got from polymer is directed toward the NPU (nitrogen purification unit)

6)Nitrogen make-up is upstream the filter

7)Chips at 185-195°C by gravity flow to the crystallizer



PRECRYSTALLIZATION

Fluidized bad:

1)High agitation in zone no. 1 to avoid sticking of chips

2)Medium agitation in zone no. 2 to get the whole crystallization of chips

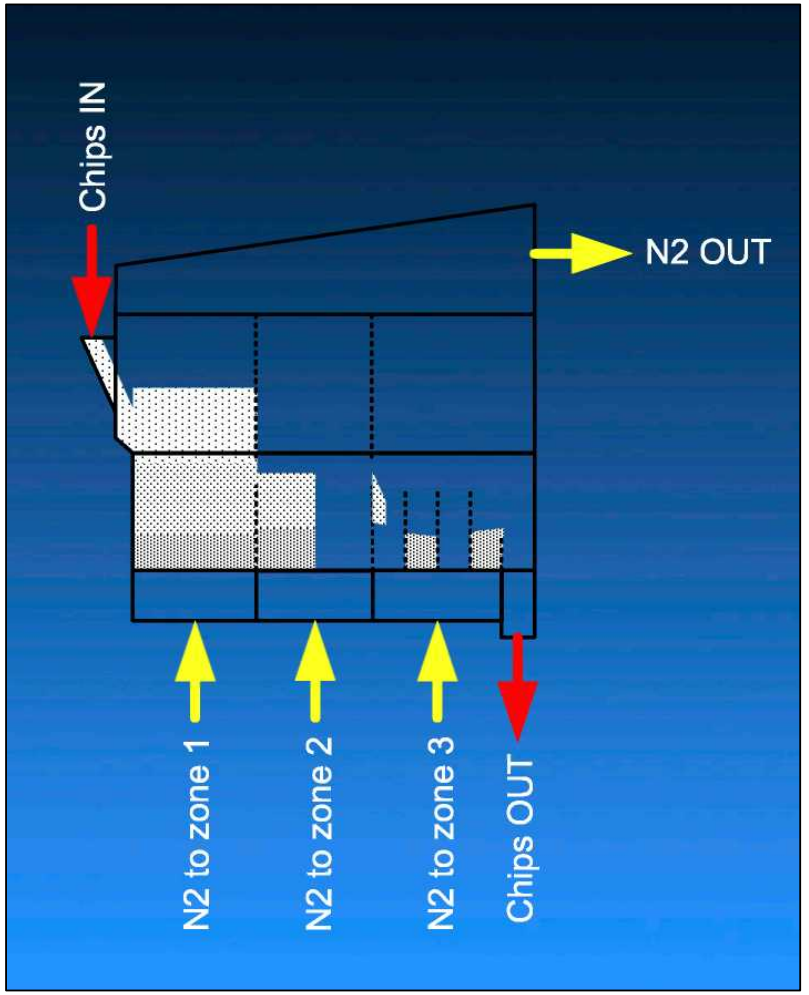
3)Low agitation in zone no. 3 to increase the residence time

4)Primary crystallization

5)Fast heating of chips

6)Dust removal

7)Operation under nitrogen to avoid any oxidation problem and to allow high temperature



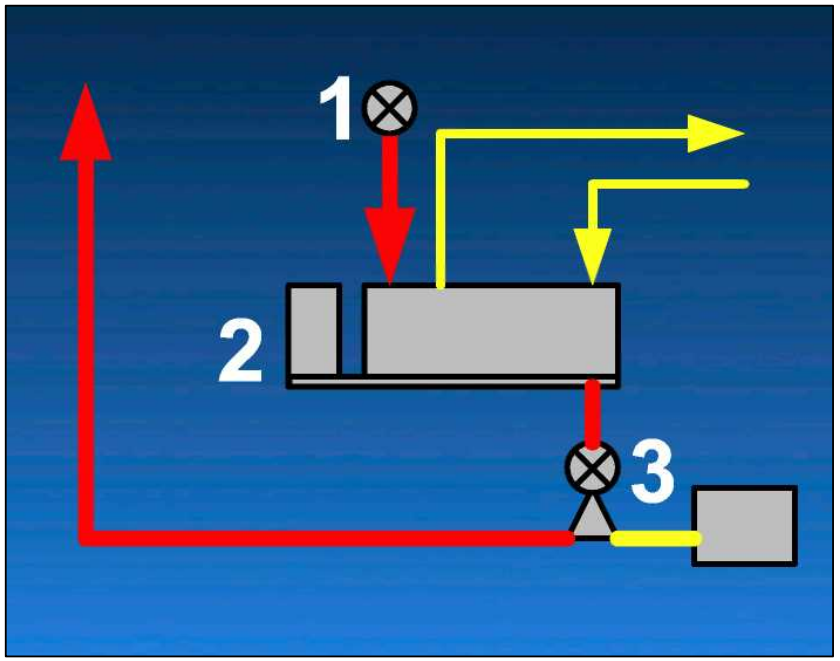
CRYSTALLIZATION

The section is composed by :

1) **Inlet rotary valve**

2) **Crystallization**

3) **Hot conveying system**



CRYSTALLIZATION

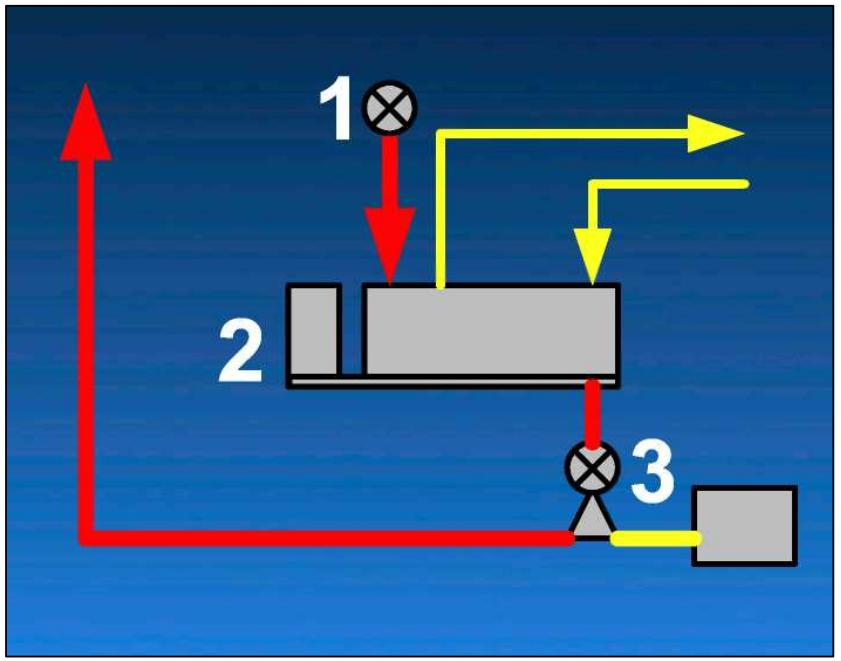
Targets :

1)To consolidate the crystallization (secondary crystallization)

2)To increase chips' temperature up to 200-210 °C (reaction temperature)

3)To reduce the acetaldehyde

4)To homogenize the temperature of chips and to control the exothermic reaction



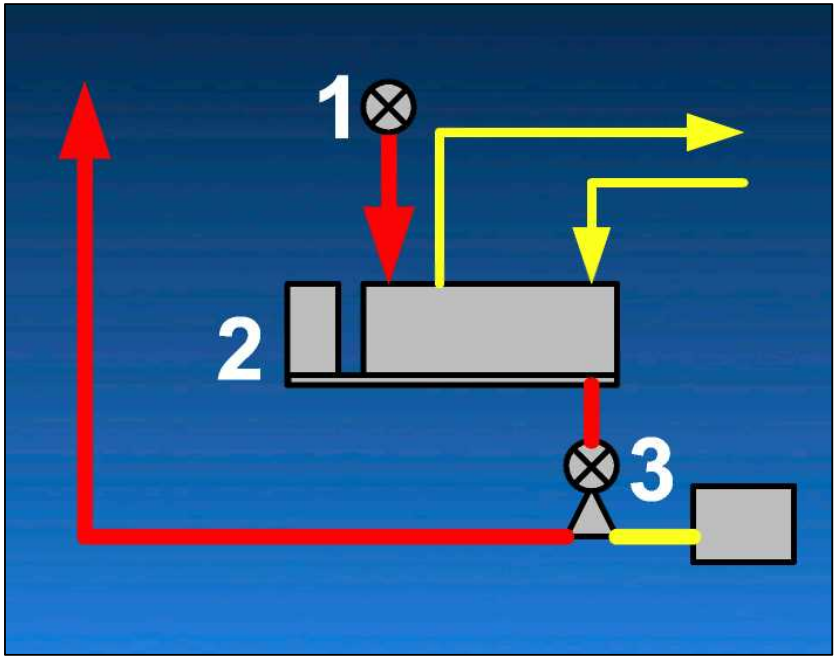
CRYSTALLIZATION

Working principles :

1)The polymer coming from precrystallization flows into the crystallizer (2) through the rotary valve (1)

2)The crystallizer has a residence time of about 40 minutes agitating the chips mechanically and increasing temperature up to 200-210°C. Nitrogen flow keeps low the VOC

3)The chips from the crystallizer through rotary valve (3) and the hot conveying system go to the reactor SSP



CRYSTALLIZER

1)The equipment is heated by HTF circulating inside the shafts and the jacket

2)The shafts rotate and agitate the chips minimizing the frictions and reducing the dust generation

3)The residence time is uniform

4)The flow pattern is a typical “plug flow”

Crystallization

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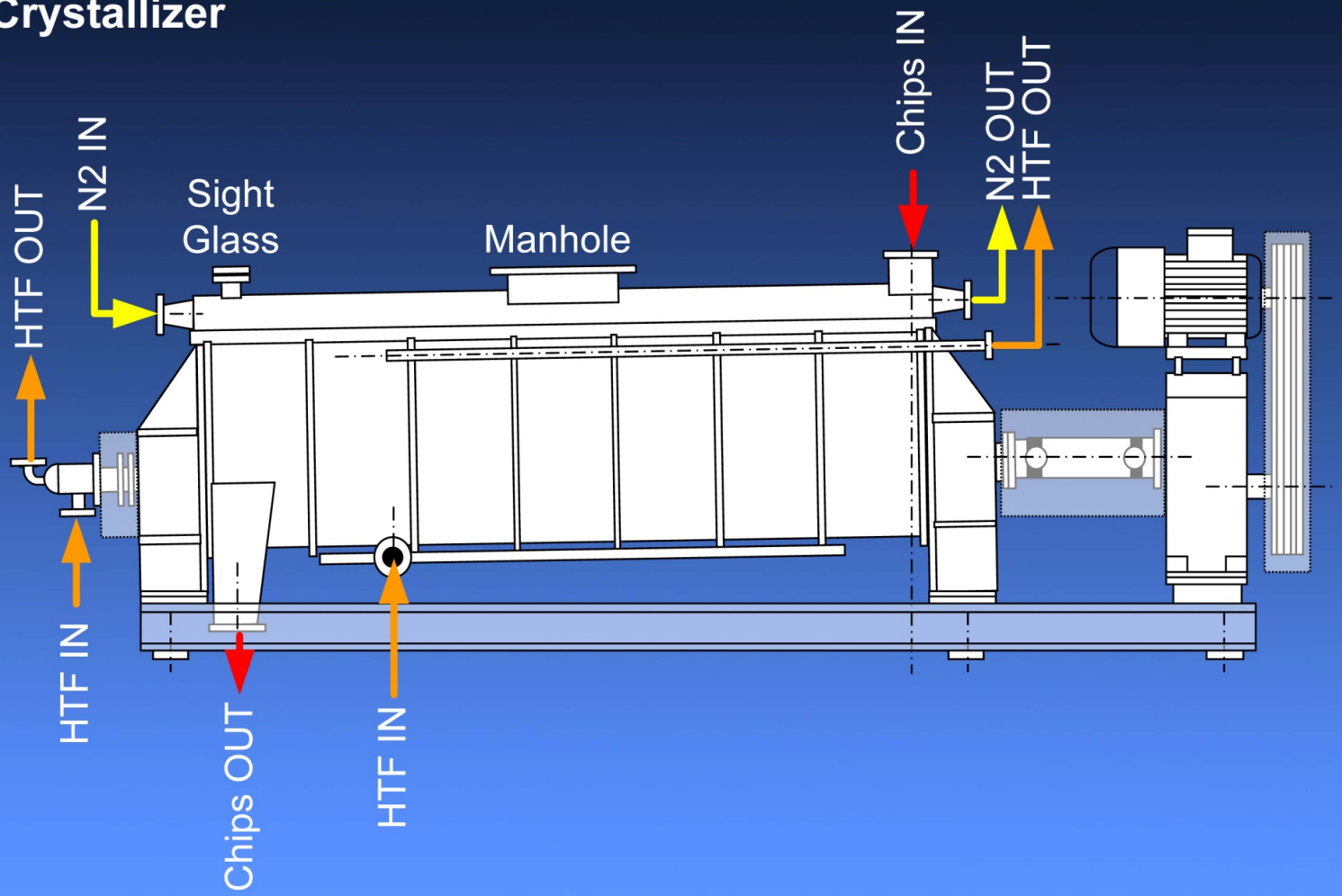
Crystallizer



Crystallizer

CRYSTALLIZATION

HOT CONVEYING SYSTEM

The system has the following characteristics

-Dense phase

-Low velocity to minimize dust formation

-Low nitrogen pressure

-Reduced nitrogen consumption

CRYSTALLIZATION

HOT CONVEYING SYSTEM

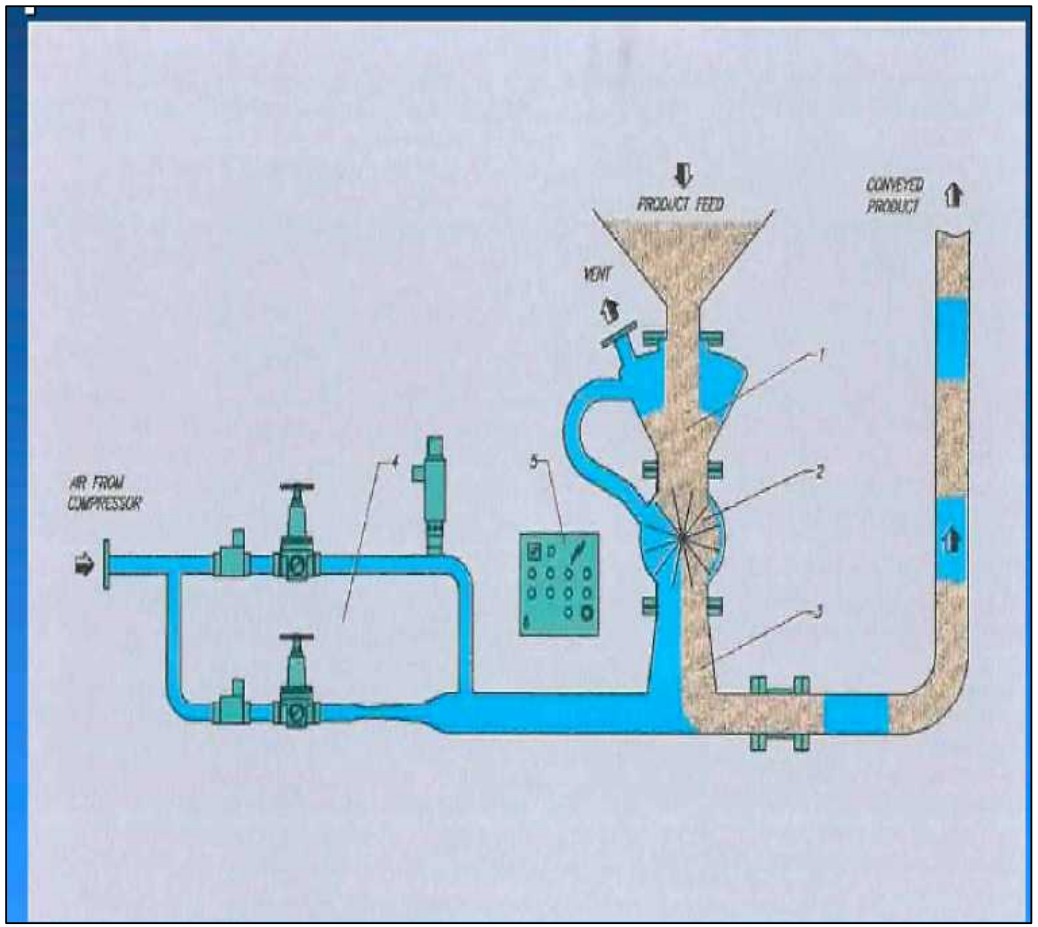
1)Inlet silo

2)Special rotary valve for hot service

3)Gas injection system

4)Gas control system

5)PLC



SOLID STATE POLYMERIZATION

The section is composed by :

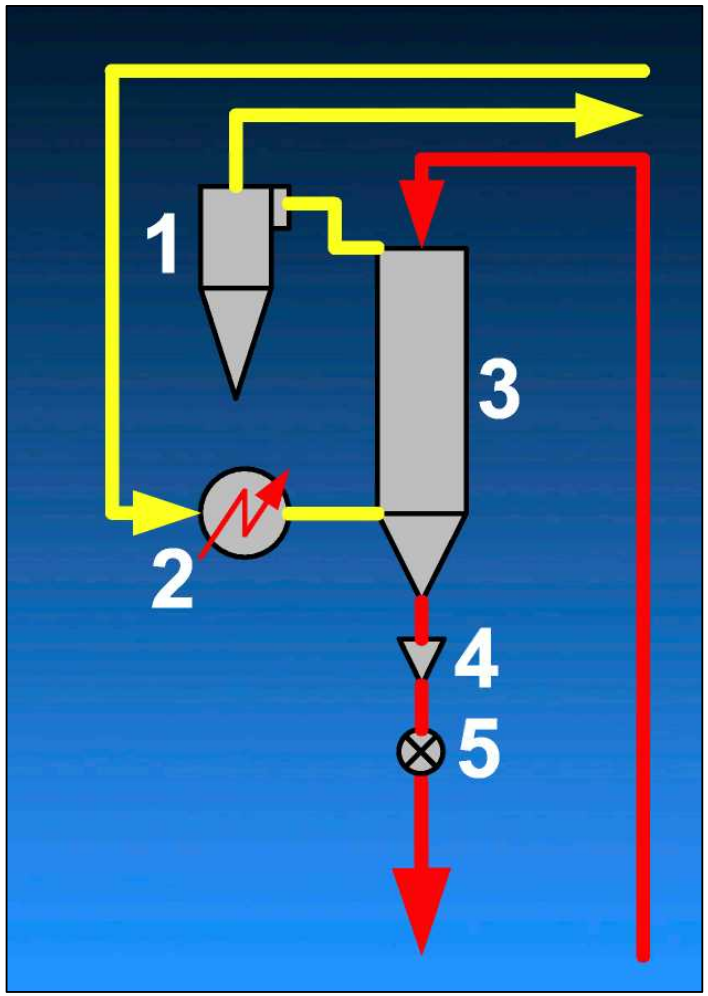
1)Cyclone

2) Heater

3)Reactor SSP

4)Screen with agitator

5)Outlet rotary valve



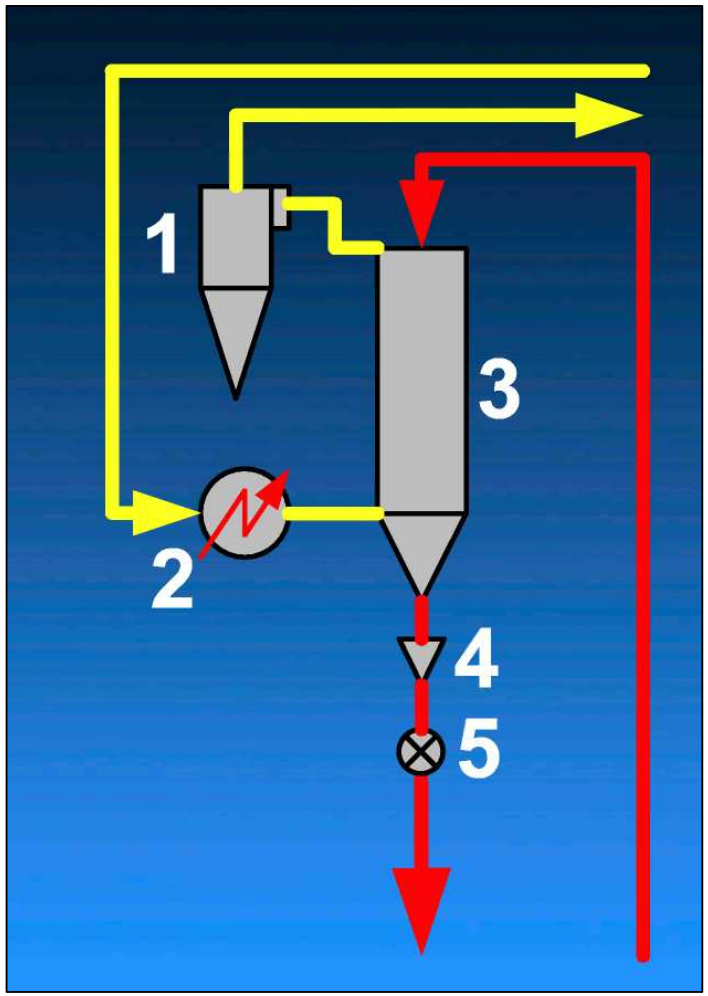
SOLID STATE POLYMERIZATION

Targets:

1)Increase the viscosity of chips

2)Plug flow and homogeneous residence time

3)Further reduction of acetaldehyde (<1ppm)



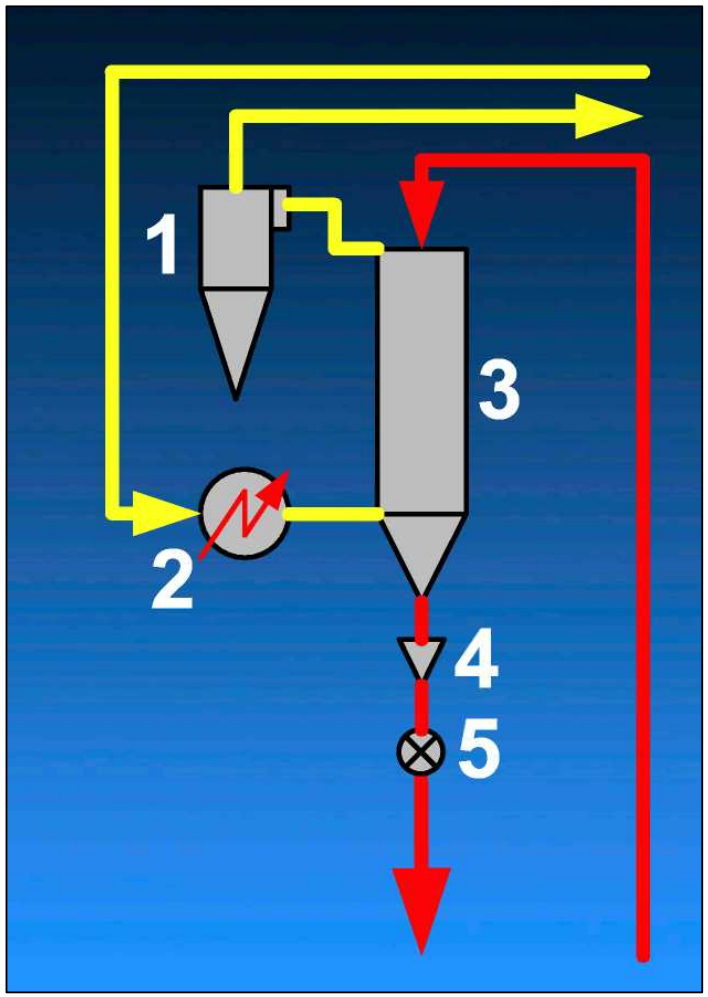
SOLID STATE POLYMERIZATION

Working principles:

1)The chips coming by the hot conveying system enter into SSP reactor (3), whete they will stay for a time long enough to increase the viscosity.

2)Nitrogen coming from NPU section is heated in th heater (2) and fed in the bottom of (3) to remove VOC

3)Nitrogen from topo of reactor goes to the cyclone (1) before going to precrystallizer circuit.



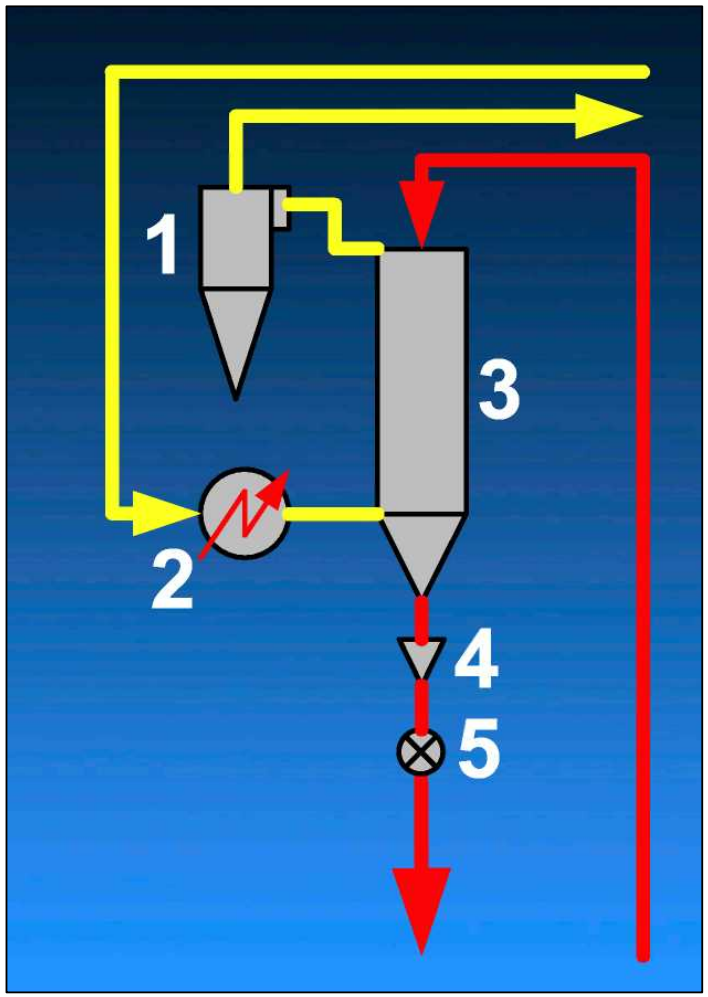
SOLID STATE POLYMERIZATION

Working principles:

4)The chips coming from SSP pass through an agitated screen to remove or destroy small polimer lumps.

5)The outlet rotary valve (5) keep constant the quantity of polymer inside the reactor (3), controlled by radar level with an inverter.

3)Chips from the bottom go to the cooling section.



COOLING SECTION

The section is composed by :

1)Blower

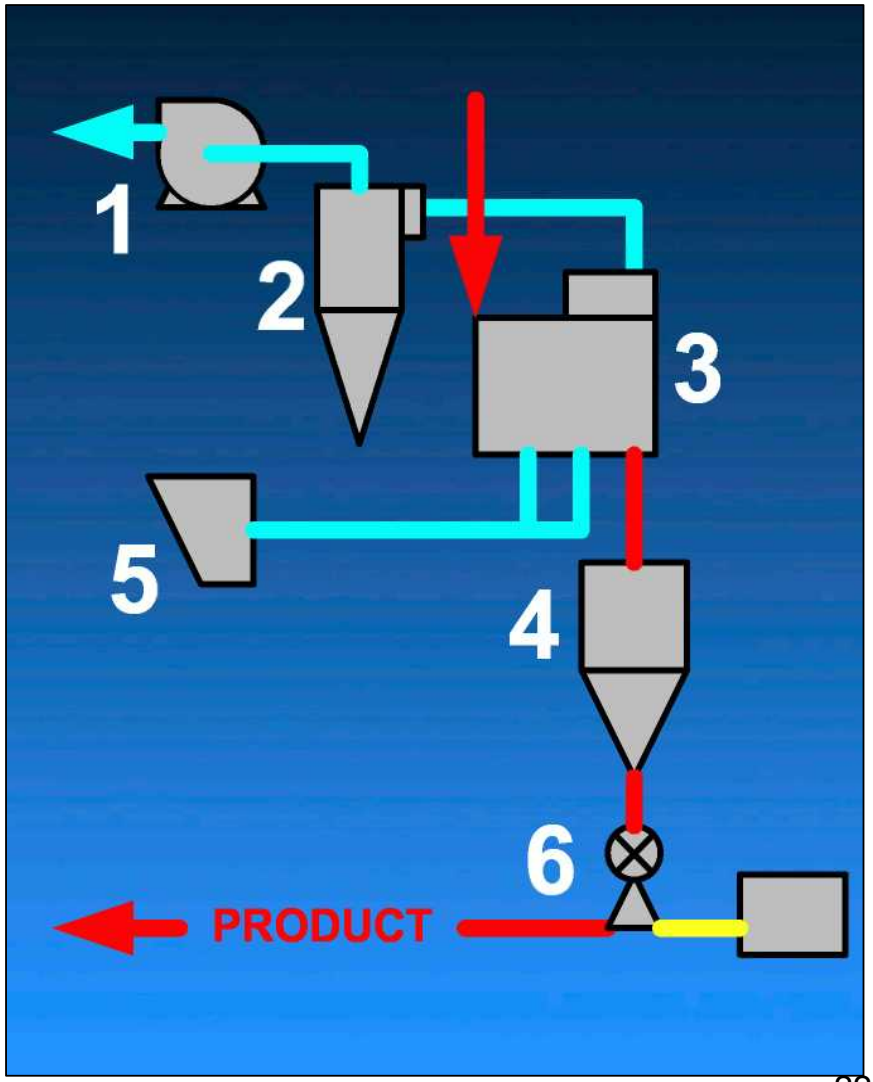
2)Cyclon

3)Cooling fluidized bed

4)Unloading silo

5)Filter on air inlet

6)Pneumatic conveying system

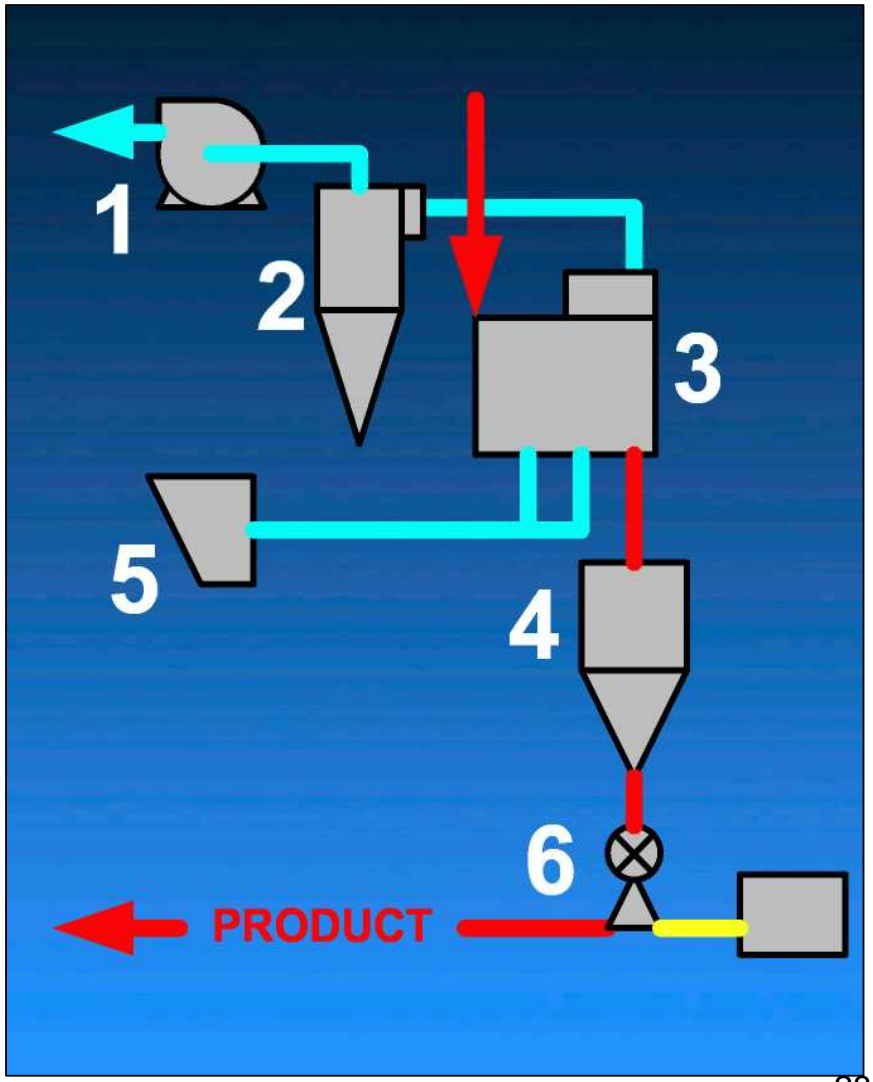


COOLING SECTION

Targets:

1)To cool down chips coming out from the reactor at about 60-70°C fluidized bed

2)Remove dust formed inside the system at a value less than 100 ppm

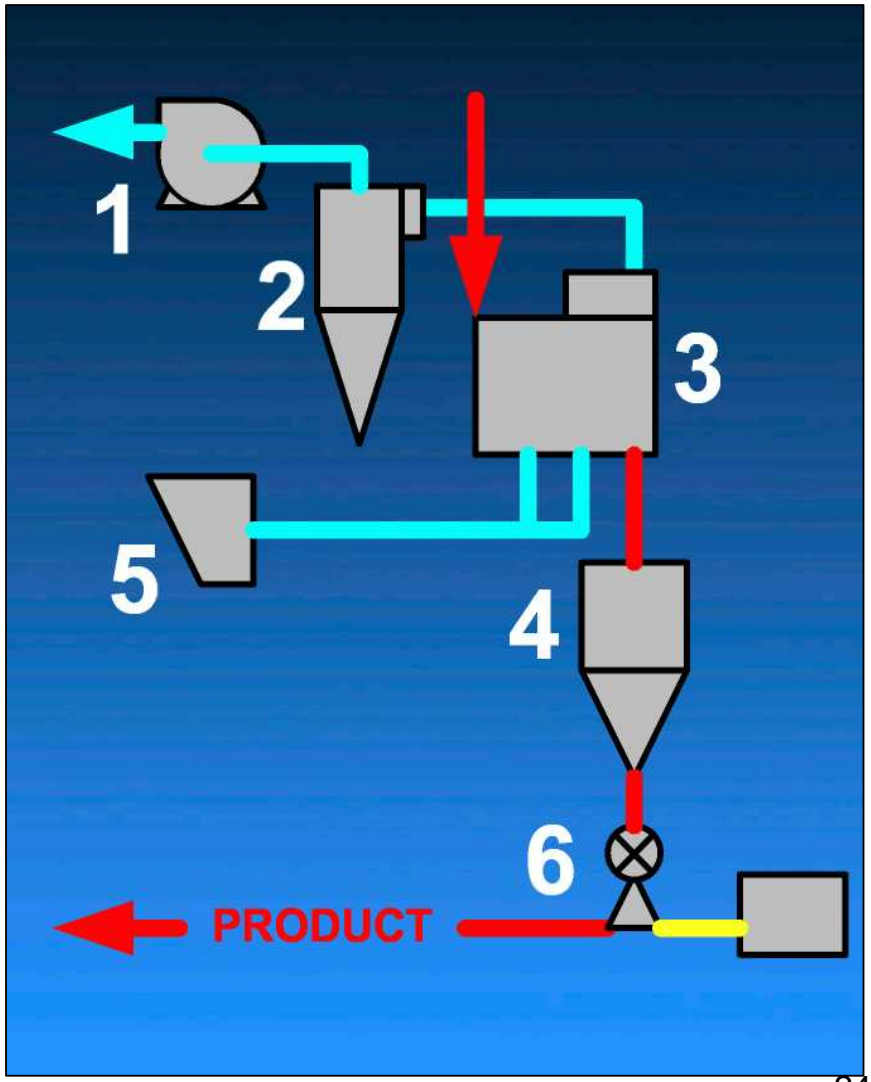


COOLING SECTION

Working principles:

-There is a blower (1) that suct air through a filter (5) into the fluidized bed (3).

-The fluidized bed has two adjacent rooms where the chips come down from the reactor through a rotary valve.

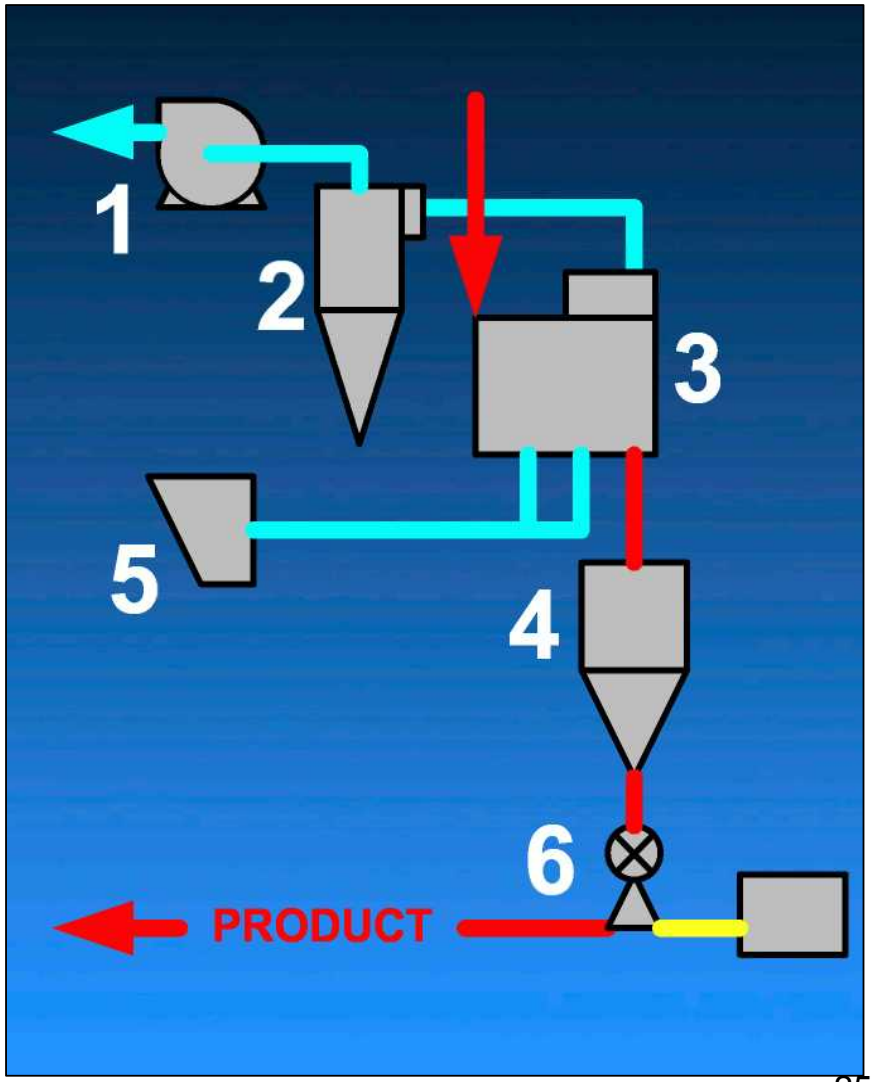


COOLING SECTION

Working principles:

-The cyclon (2) remove dust before discharging air to atmosphere.

-The chips on the outlet of the fluidized bed are collected in a silo (4) before going by a pneumatic conveying (6) system to the final storage



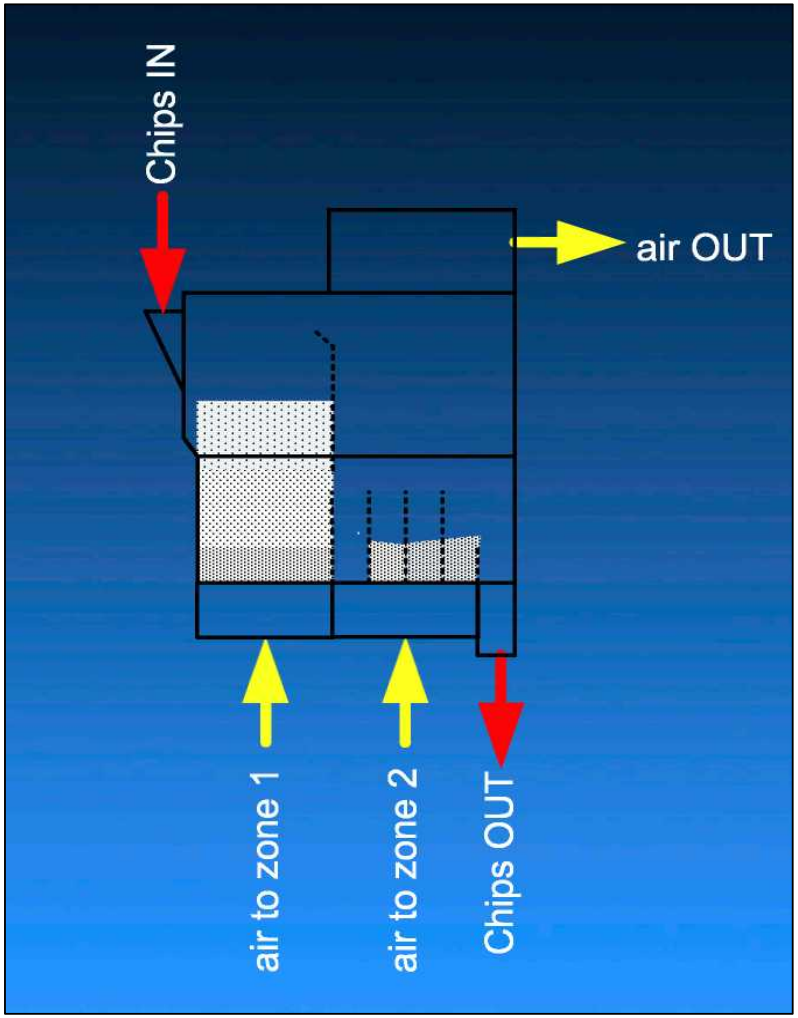
COOLING SECTION

Cooling fluidized bed

-Fluidized bed in air

-Outlet temperature of chips in the range 60-70°C

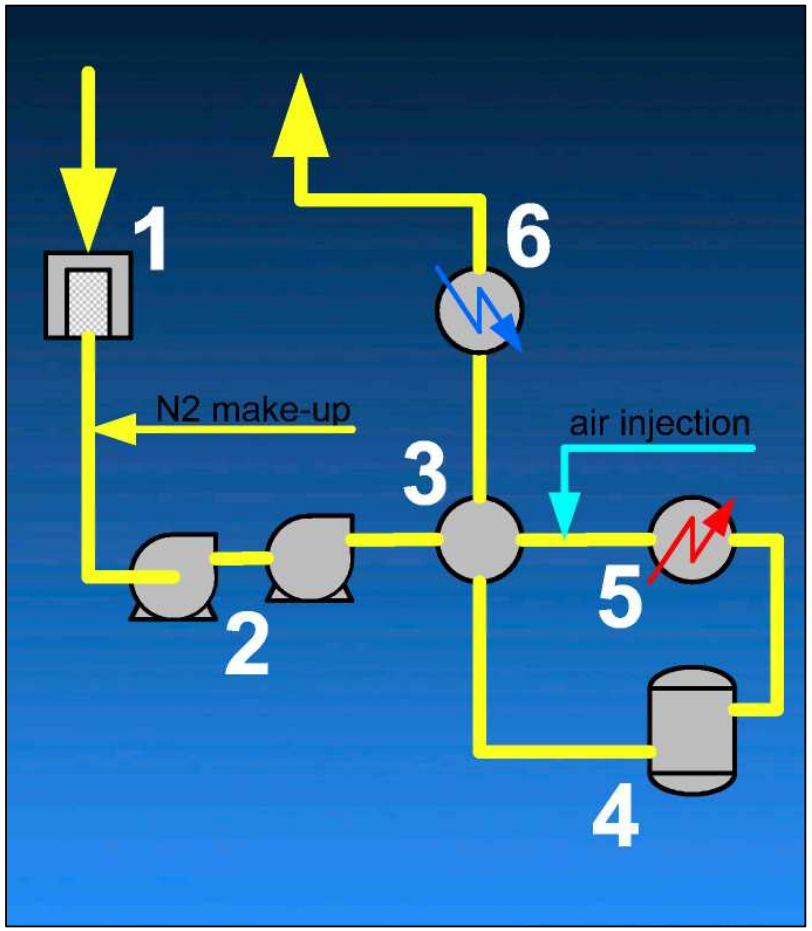
-Dust content < 100 ppm



NPU OXIDATION

The section is composed by:

1) **Hot nitrogen filter**
2) **Exhaust nitrogen blower**
3) **Economizier**
4) **NPU reactor**
5) **NPU heater**
6) **NPU cooler**

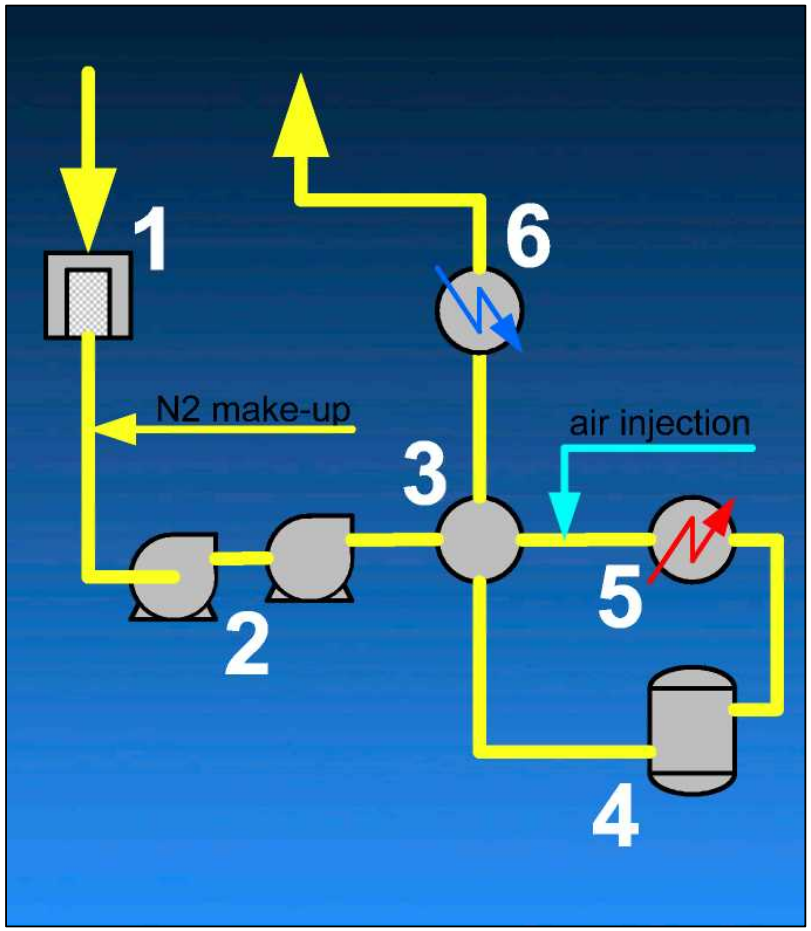


NPU OXIDATION

Targets:

1)Transform VOC by air injection and catalyst in water and carbon dioxide

2)Condensation of water coming out from polymerization and oxidation



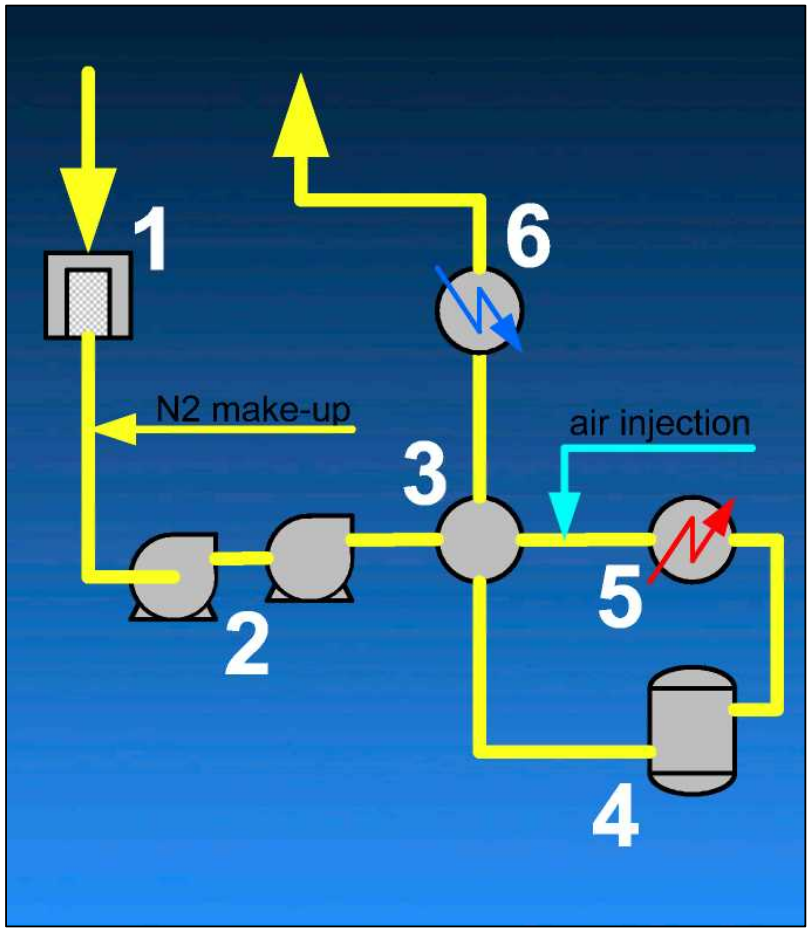
NPU OXIDATION

Working principles:

1)Exhaust nitrogen coming from precrystallization circuit is filtered by hot nitrogen filter (1) at <= 10 micron

2)Two blowers compress exhaust gas (2) into NPU

3)On the suction of blowers (2) there is N2 make-up to keep constant the pressure in the plant



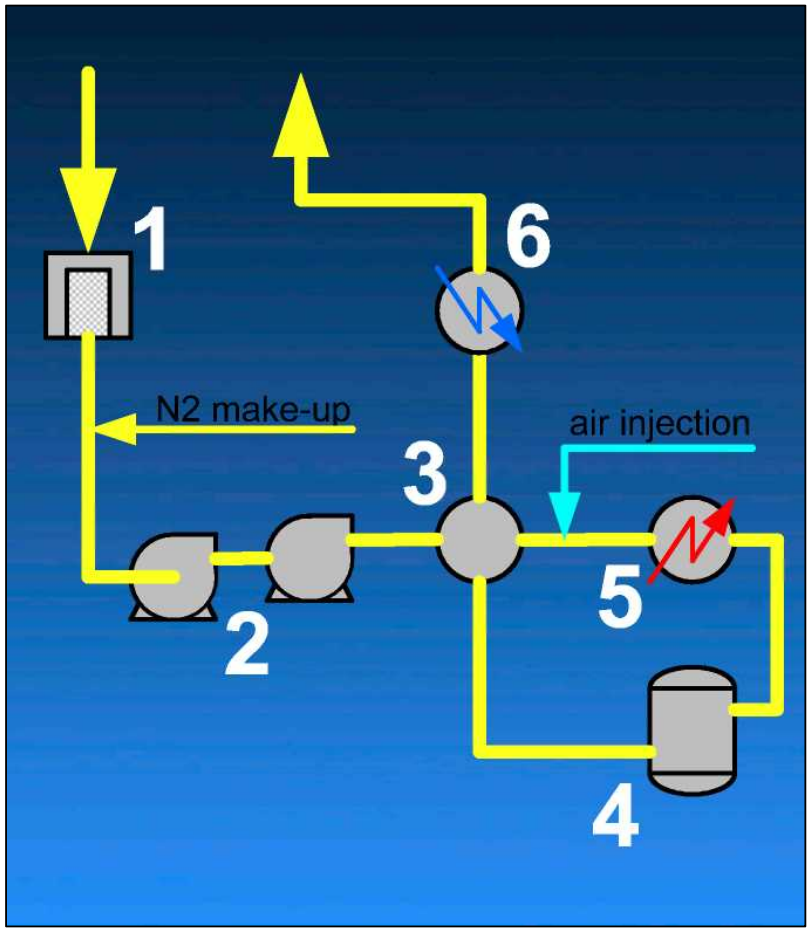
NPU OXIDATION

Working principles:

4)Exhaust nitrogen after blowers goes through the economizer (3) to recover heat

5)From the economizer the gas by the heater is heated up to 300-330°C

6)The hot nitrogen mixed with a controlled amount of air goes to the NPU reactor (4) where we have the oxidation . In this step we can observe an increase of temperature of about 10-20°C.



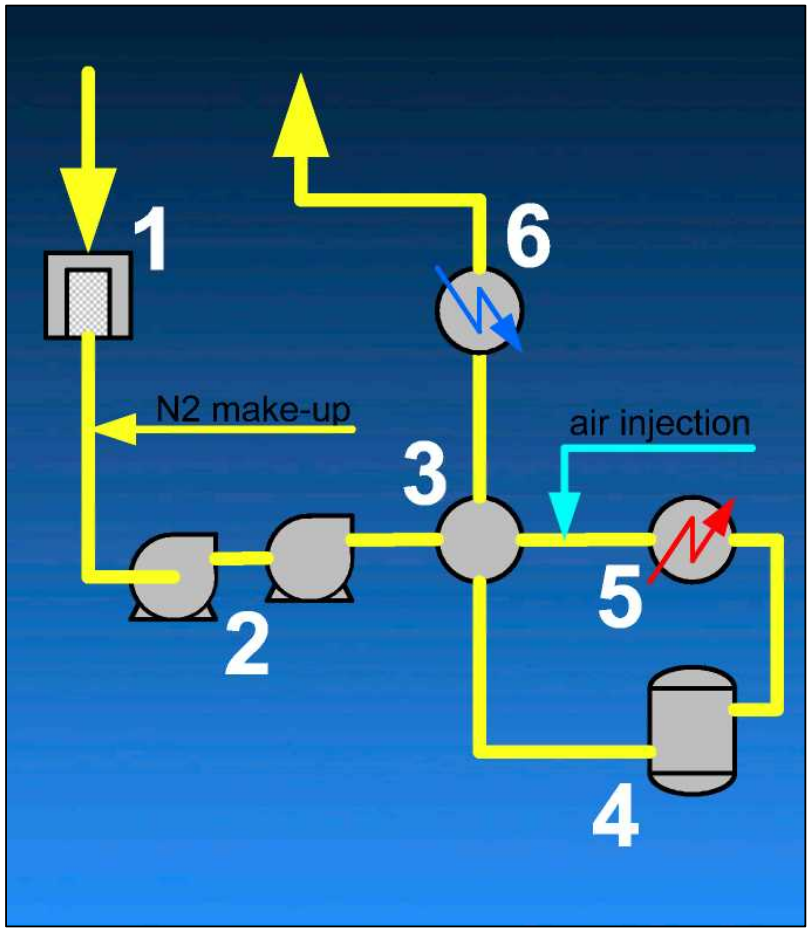
NPU OXIDATION

Working principles:

7)On the outlet of NPU we have an oxygen analyzer to control O2 at < 50 ppm regulating the air injection valve (5)

8)The nitrogen goes through the economizer (3) to release some heat

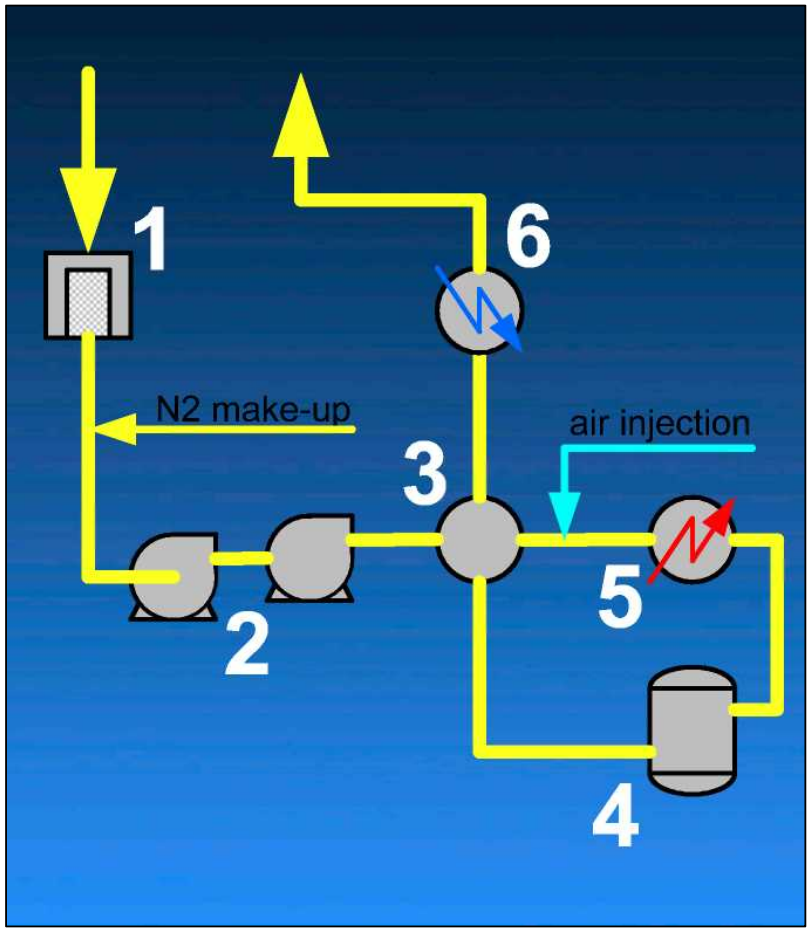
9)The gas as a mixture of nitrogen, CO2 and steam goes through the cooler (6) achieving a temperature of about 35-45°C. The steam is condensated and is discharged by a trap.



NPU OXIDATION

Working principles:

10)The gas goes to the NPU drying and regeneration section



NPU drying and regeneration

The section is composed by:

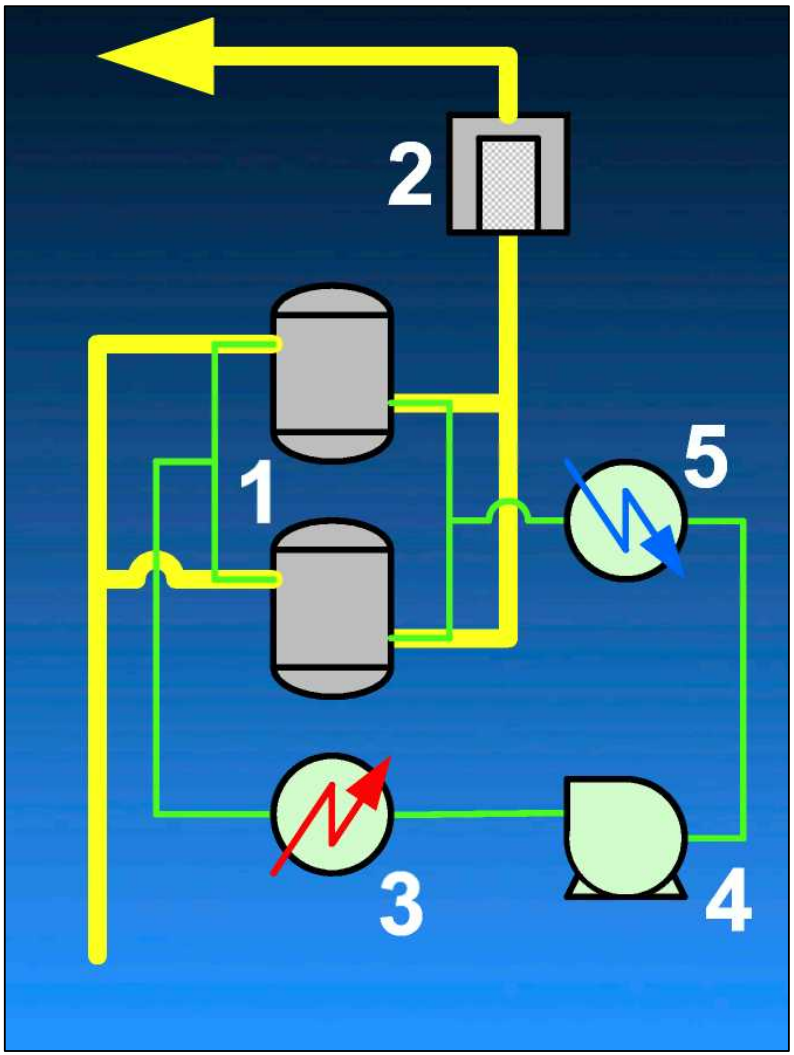
1) **Dryers**

2) **Cold nitrogen filter**

3) **Heater for regeneration**

4) **Blower for regeneration**

5) **Cooler for regeneration**

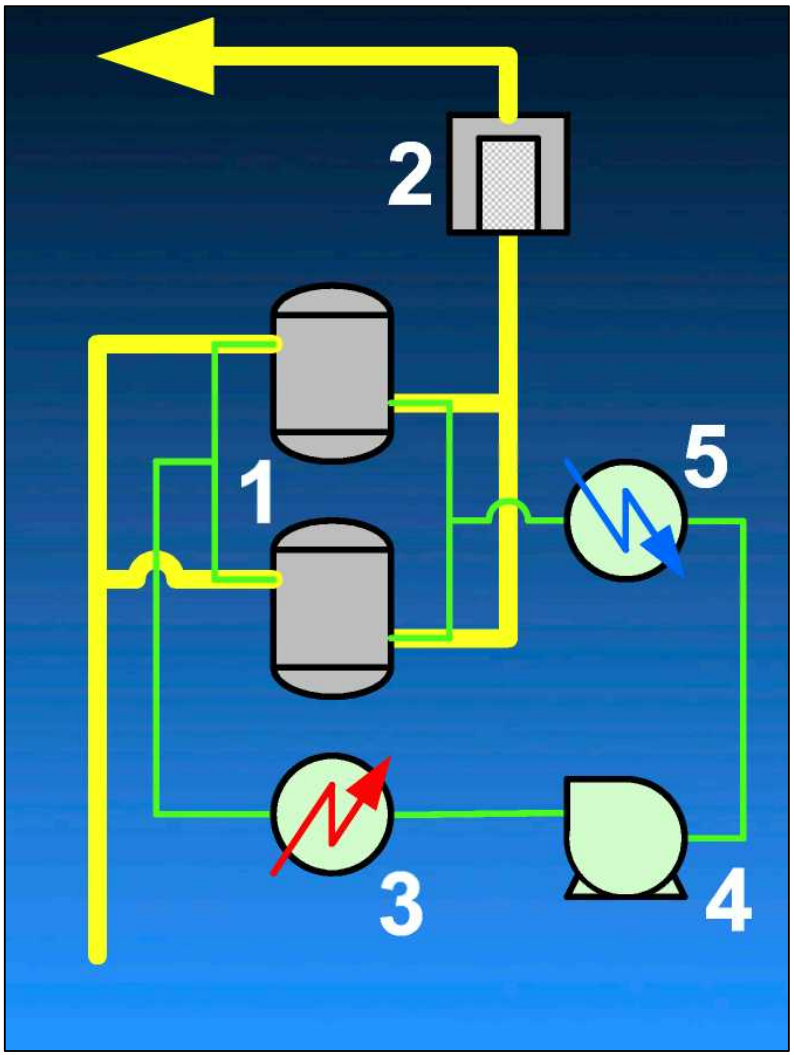


NPU drying and regeneration

Targets:

1)To collect the water residue still present in purified gas coming from "Oxidation NPU" to get a Dew point < -40°C

2)To remove the water adsorbed by molecular sieves and renew them



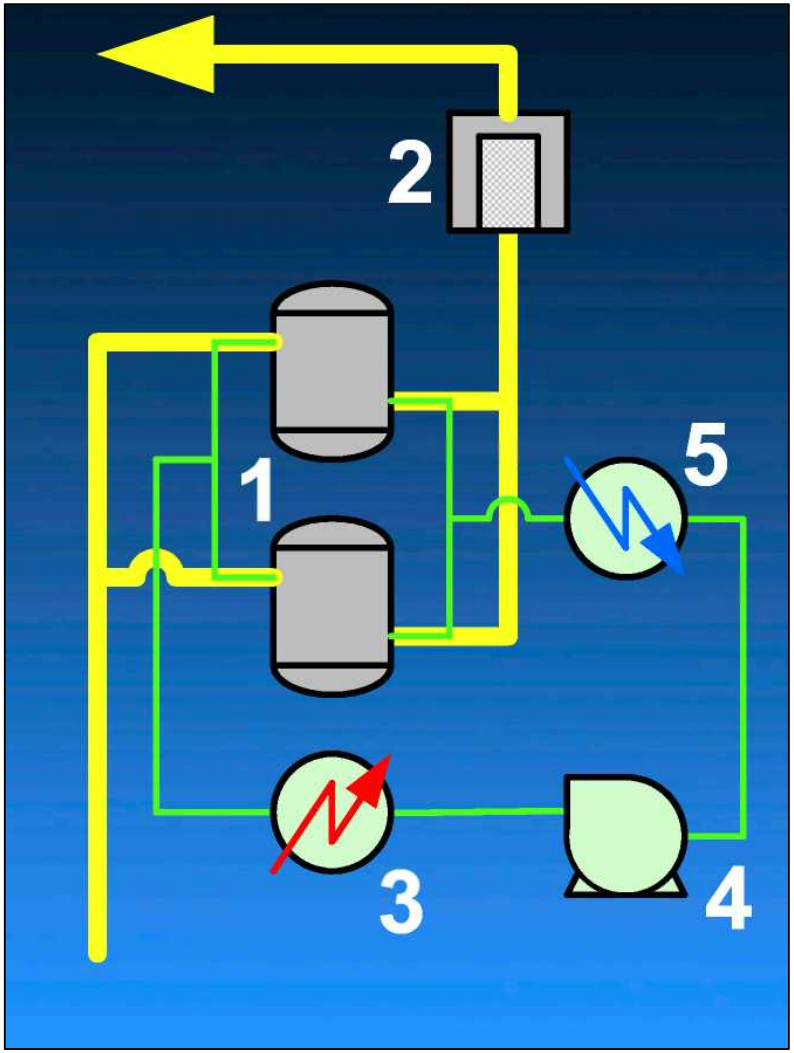
NPU drying and regeneration

Working principles:

1)The nitrogen cooled by the water cooler goes through the molecular sieves (1). The residual water is catched to get a dew point of <40°C.

2)The gas goes through the cold filter to avoid that dust of molecular sieves could contaminate the polymer.

3)The nitrogen once purified and dried is pumped into the section " solid state polymerization"



NPU drying and regeneration

Working principles:

1)While one dryer is working the second one is under regeneration

2)The regeneration is done using nitrogen heated up to 250° - 280°C by the blower (4). On the outlet the nitrogen is cooled by cooler (5)

3)The water once condensed is removed by a steam trap.

4)The regeneration cycle is 8 hours of heating and 4 hours of cooling