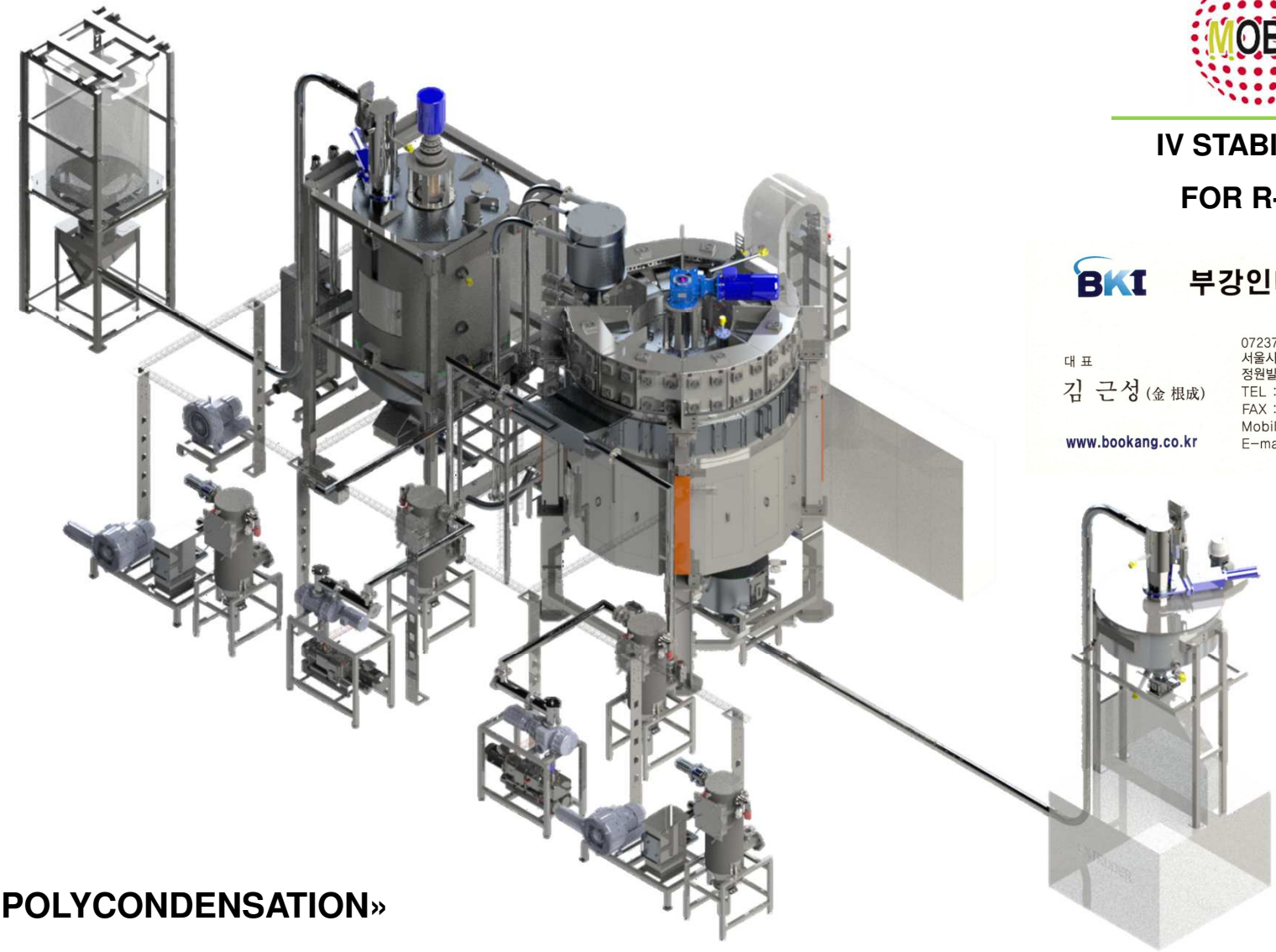

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IV STABILIZER

FOR R-PET

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E-mail : kskim2020@gmail.com

MOBY :

«SOLID STATE POLYCONDENSATION»

AND «SUPER-CLEAN» FOR PET

USING INFRARED RADIATIONS + VACUUM

PATENTED TECHNOLOGY

sb plastics machinery

SUMMARY OF THE PRESENTATION

PET
POLYESTER

- INTRODUCTION TO MOBY SYSTEM
- ADVANTAGES OF USING INFRARED AND VACUUM
- SOLID STATE POLYCONDENSATION (SSP) OF PET
- SUPER-CLEAN OF PET
- APPLICATIONS
- MOBY LAB

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PET
POLYESTER

- **INTRODUCTION TO MOBY SYSTEM**
- ADVANTAGES OF USING INFRARED AND VACUUM
- SOLID STATE POLYCONDENSATION (SSP) OF PET
- SUPER-CLEAN OF PET
- EXAMPLES OF APPLICATIONS
- MOBY LAB

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INTRODUCTION TO MOBY SYSTEM

PET
POLYESTER

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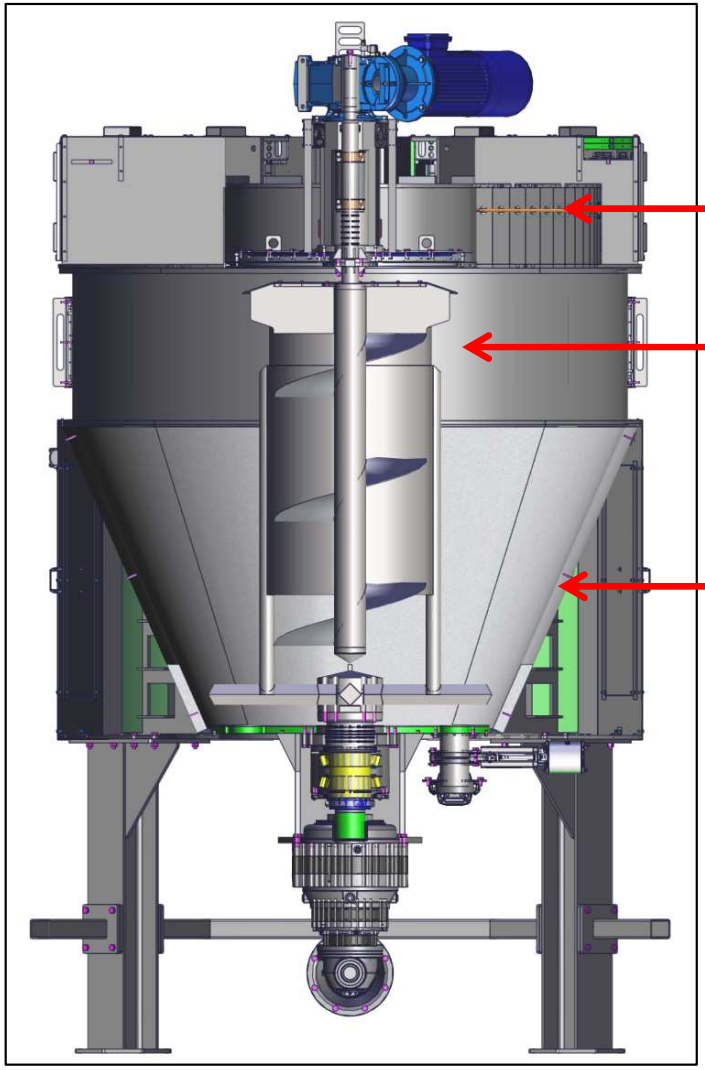
INTRODUCTION TO MOBY SYSTEM

PET
POLYESTER



HEATING

MIXING

VACUUM

SIMPLE CONCEPT → *MAXIMUM RESULT*

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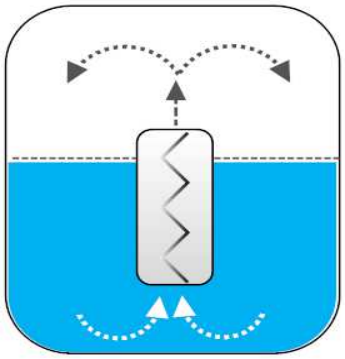
INTRODUCTION TO MOBY SYSTEM

PET
POLYESTER

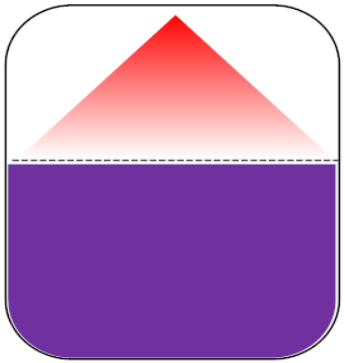
MIXING



SCREW
FEEDER

+

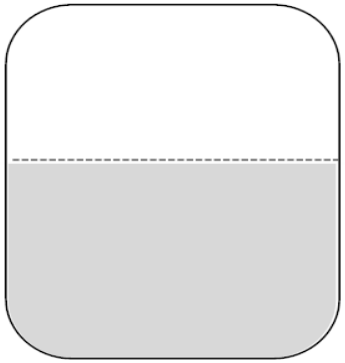
HEATING



INFRARED
RADIATIONS

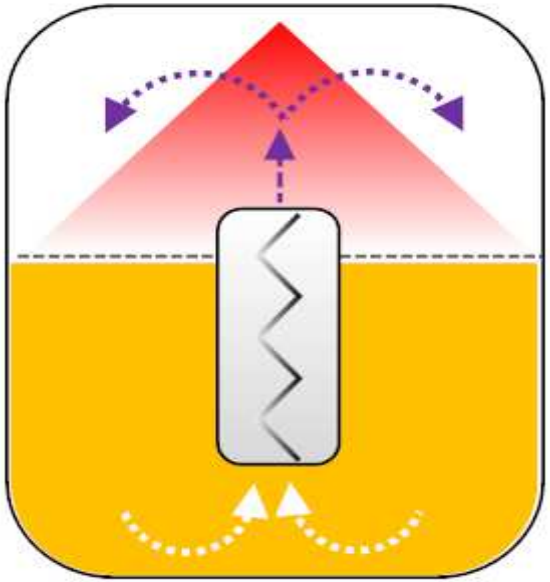
+

«STRIPPING»



VACUUM

=



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SIMPLE CONCEPT → *MAXIMUM RESULT*

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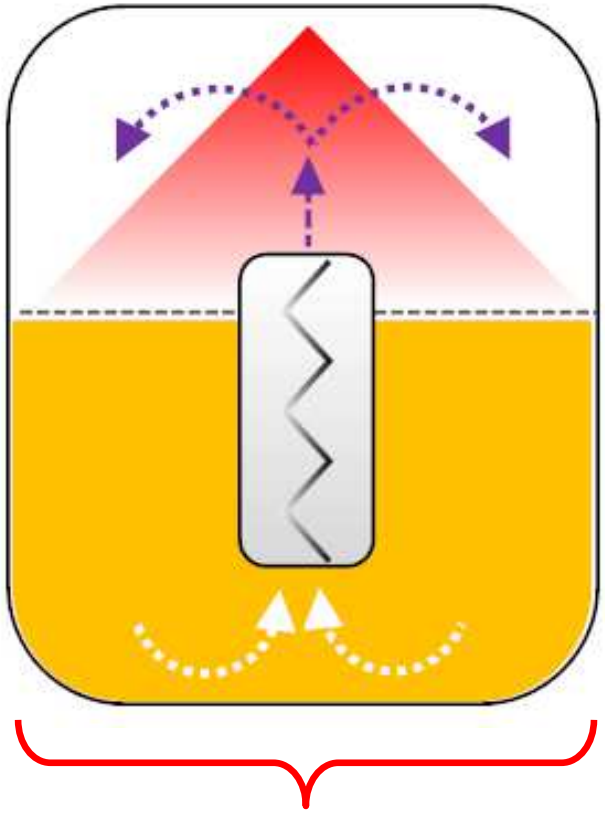
INTRODUCTION TO MOBY SYSTEM

PET
POLYESTER

The material inside the reactor is recirculated by a screw feeder in a tube and exposed to the action of infrared radiations in an ambient under vacuum



«FOUNTAIN» EFFECT

ACTION OF INFRARED RADIATIONS ON THE MATERIAL

RECIRCULATING SCREW FEEDER

AMBIENT UNDER VACUUM

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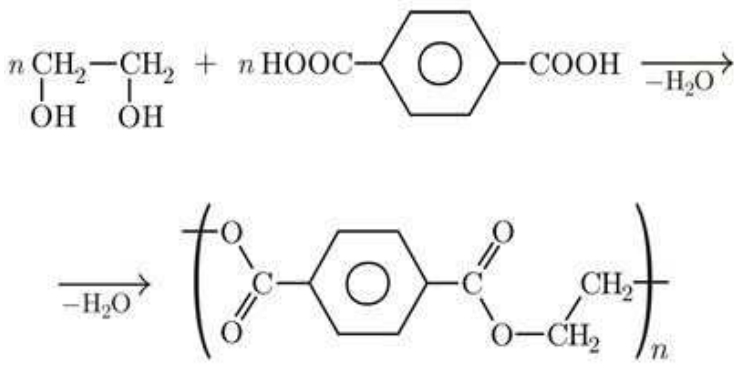
INTRODUCTION TO MOBY SYSTEM

PET
POLYESTER

MOBY is a heat treatment system usable on any kind of polymer

Polyethylene

-terephthalate



This presentation is focused on PET

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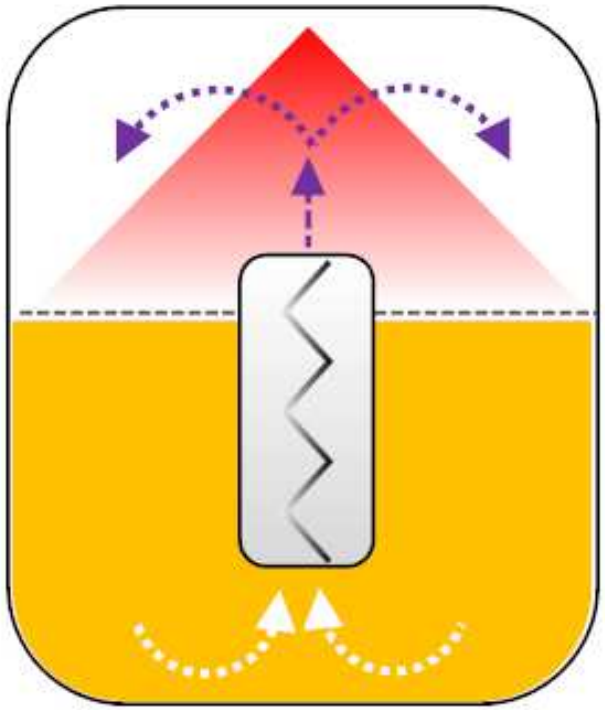
INTRODUCTION TO MOBY SYSTEM

PET
POLYESTER

The temperature is controlled directly on the material and determines the various stages of PET processing



80°C	GLASS TRANSICTION START CRYSTALLIZATION
80-160°C	CRYSTALLIZATION DEHUMIDIFICATION
200-210°C	SUPER-CLEAN (DECONTAMINATION)
>200°C	SOLID STATE POLYCONDENSATION (SSP)

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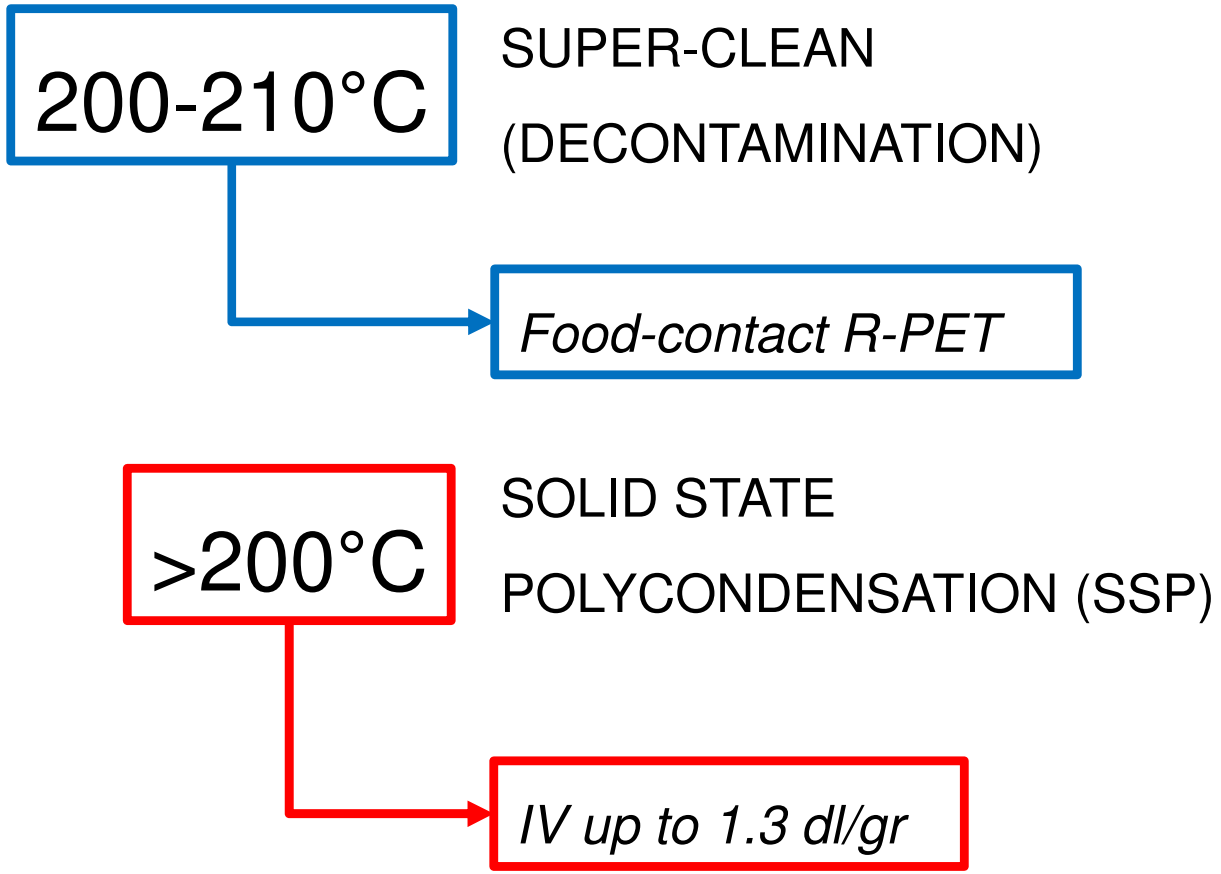
INTRODUCTION TO MOBY SYSTEM

PET
POLYESTER



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INTRODUCTION TO MOBY SYSTEM

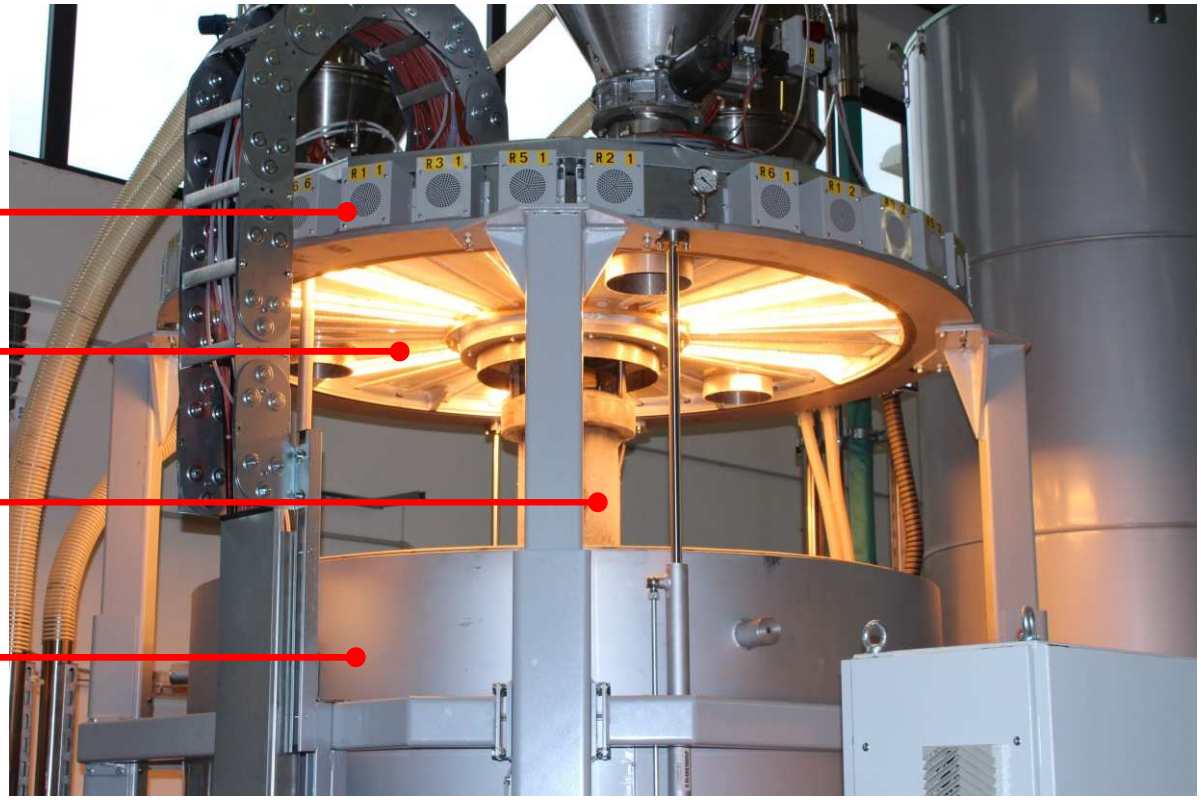
PET
POLYESTER

LID

IR GENERATORS

MIXING

REACTOR



Picture of a reactor with the lid open and the IR generators running

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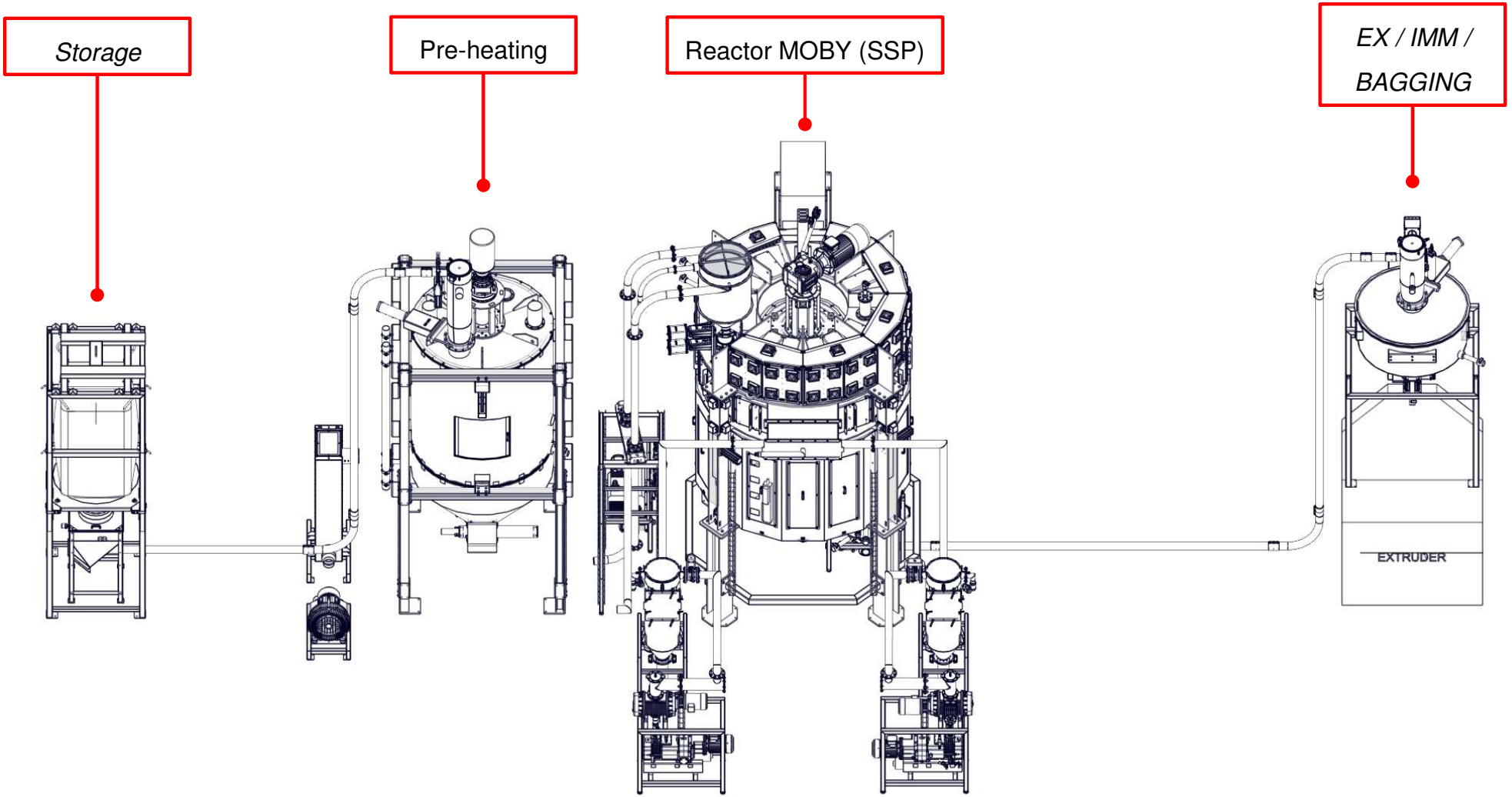
INTRODUCTION TO MOBY SYSTEM

PET
POLYESTER



MOBY plant configuration for «Solid State Polycondensation»

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PET
POLYESTER

- INTRODUCTION TO MOBY SYSTEM
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- MOBY LAB

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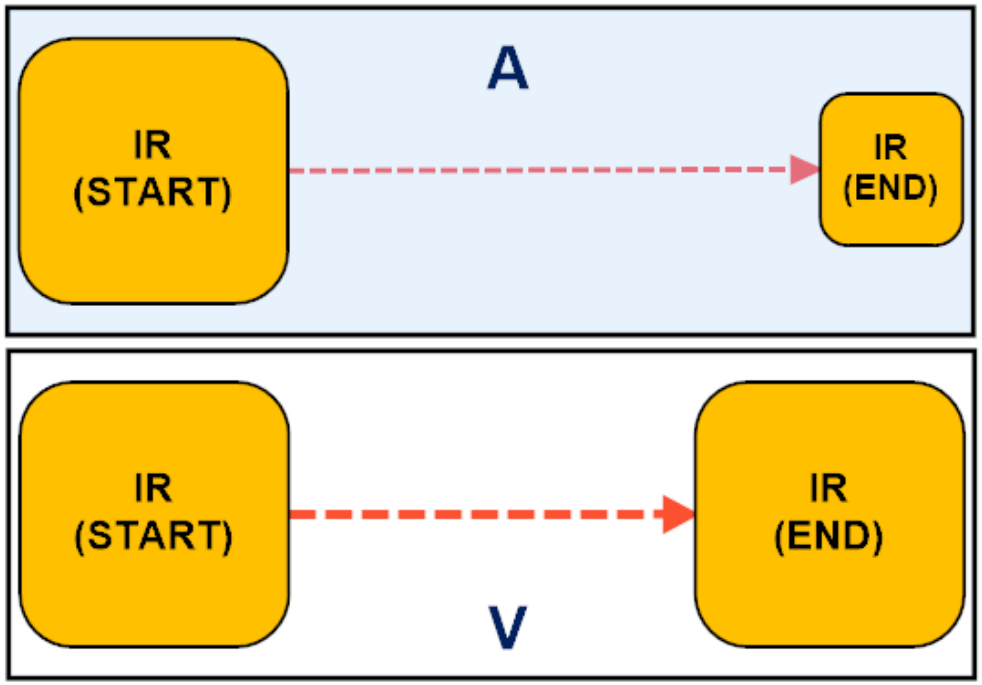
Why INFRARED RADIATIONS and VACUUM?

ADVANTAGES OF USING INFRARED AND VACUUM

BENEFIT NR 1

PET
POLYESTER

Compared to radiation in the air, the yield of the infrared radiation under vacuum increases up to 30%



HEATING IN

AIR

HEATING UNDER

VACUUM

IR under vacuum are more efficient

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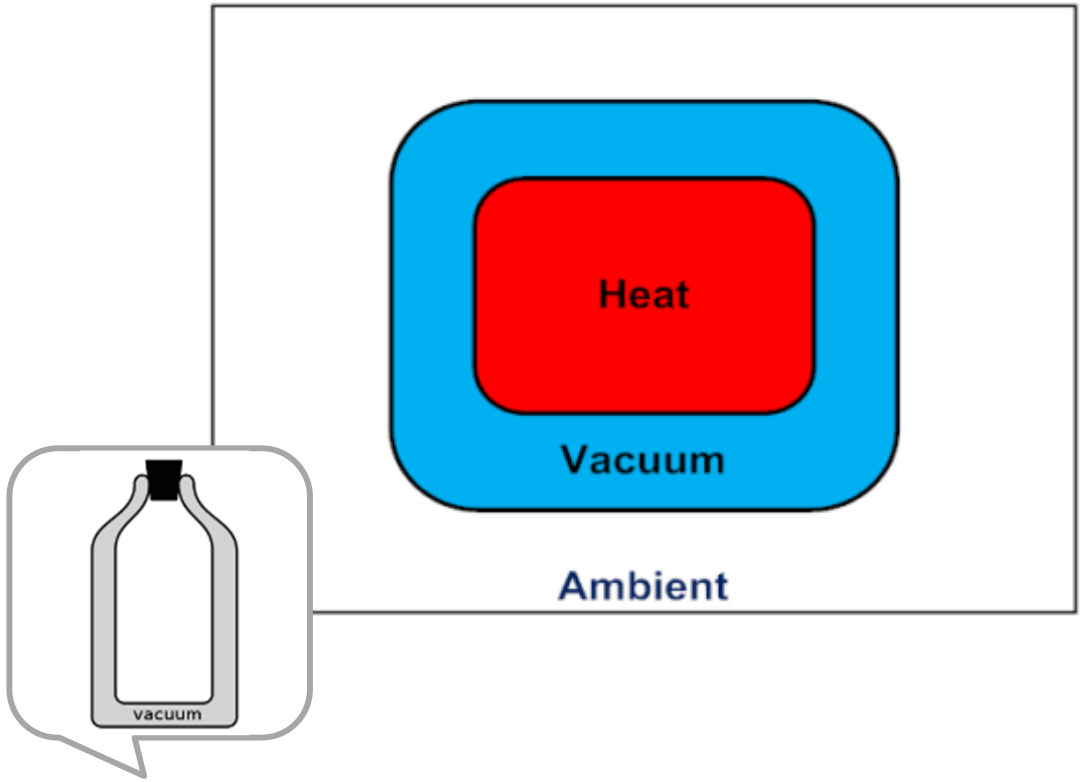
ADVANTAGES OF USING INFRARED AND VACUUM

BENEFIT NR 1

PET
POLYESTER

Vacuum increases the efficiency of IR and it's also the best thermal insulation in nature



As a vase of Dewar, the reactor does not exchange any heat with the outside, from which it is not only isolated, but independent

ADVANTAGES OF USING INFRARED AND VACUUM

PET
POLYESTER

BENEFIT NR 1

The combination of infrared with an ambient under vacuum

- Increases the energy efficiency of the heating
- Improved the energy conservation

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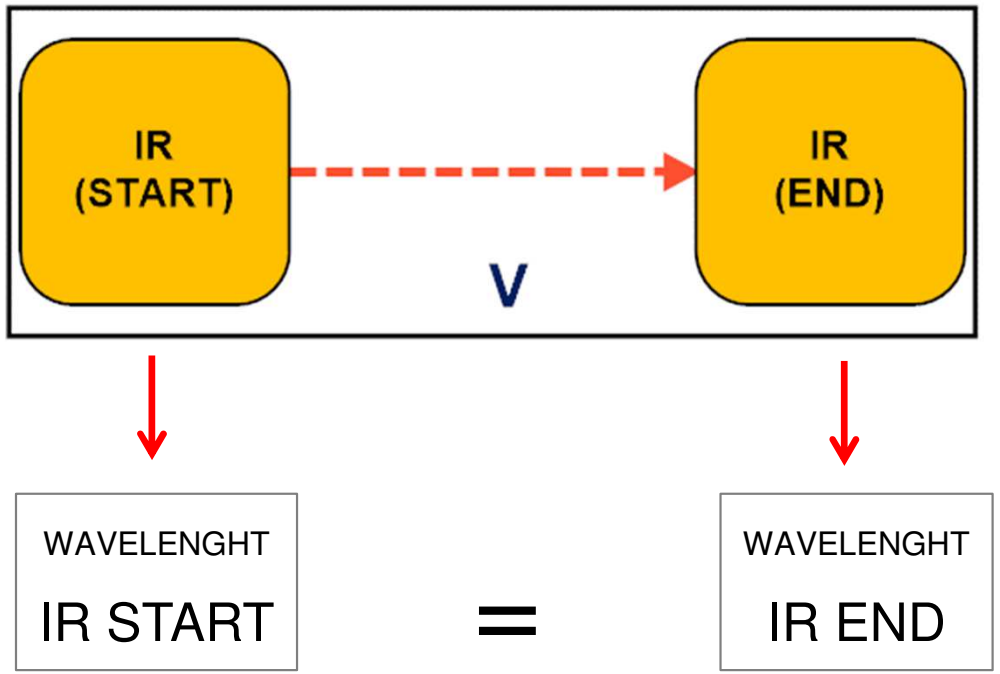
ADVANTAGES OF USING INFRARED AND VACUUM

BENEFIT NR 2

PET
POLYESTER

The radiation emitted under vacuum retains not only its energy yield, but also its wavelength



It's possible to know the type of radiation that acts on the material under treatment

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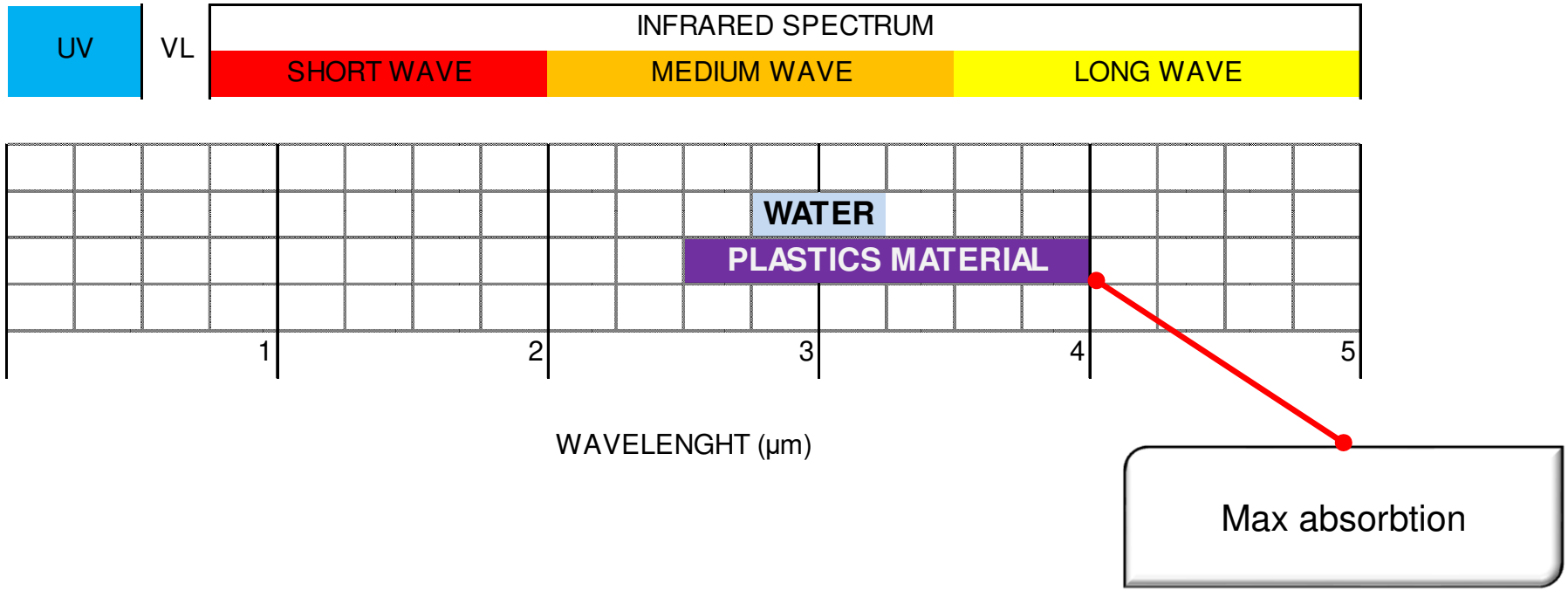
ADVANTAGES OF USING INFRARED AND VACUUM

BENEFIT NR 2

PET
POLYESTER

All bodies absorb or reflect

a specific wavelength of infrared radiation



Exploiting the Law of Wien is possible to vary the wavelength of the emitted radiation and thus obtain a more selective and efficient heating

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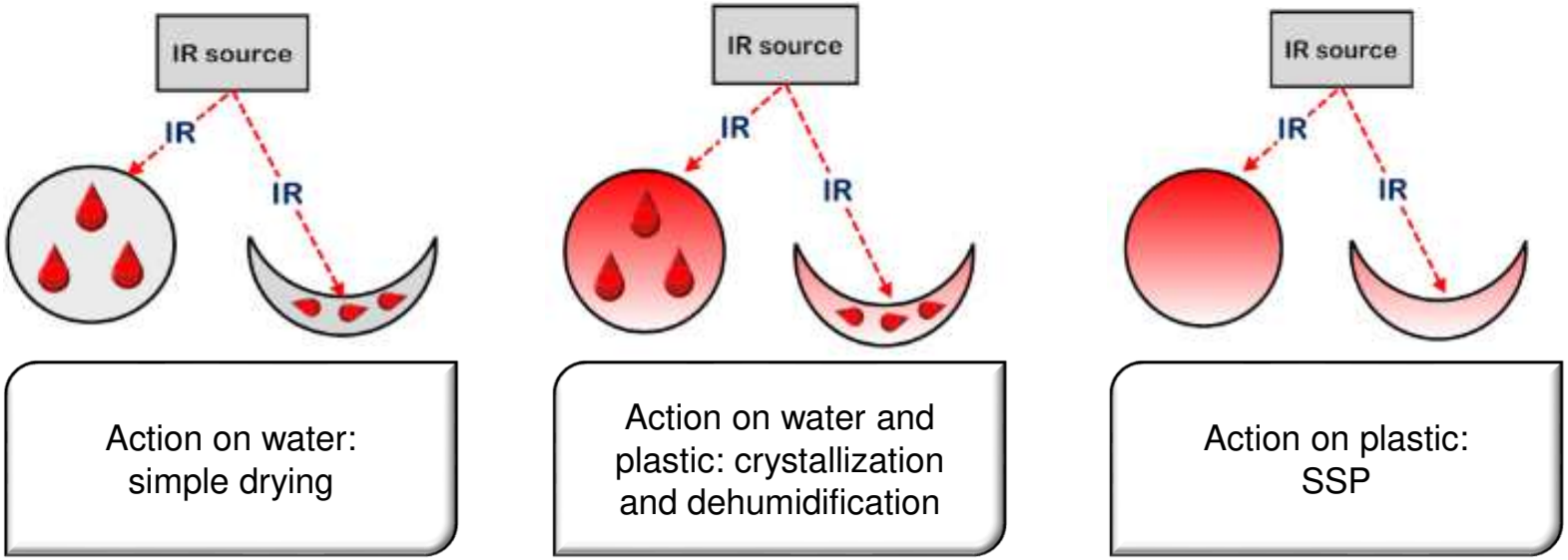
ADVANTAGES OF USING INFRARED AND VACUUM

PET
POLYESTER

BENEFIT NR 2

The combination of infrared with an ambient under vacuum

- Allows a selective heating
- Improves the utilization of the energy supplied

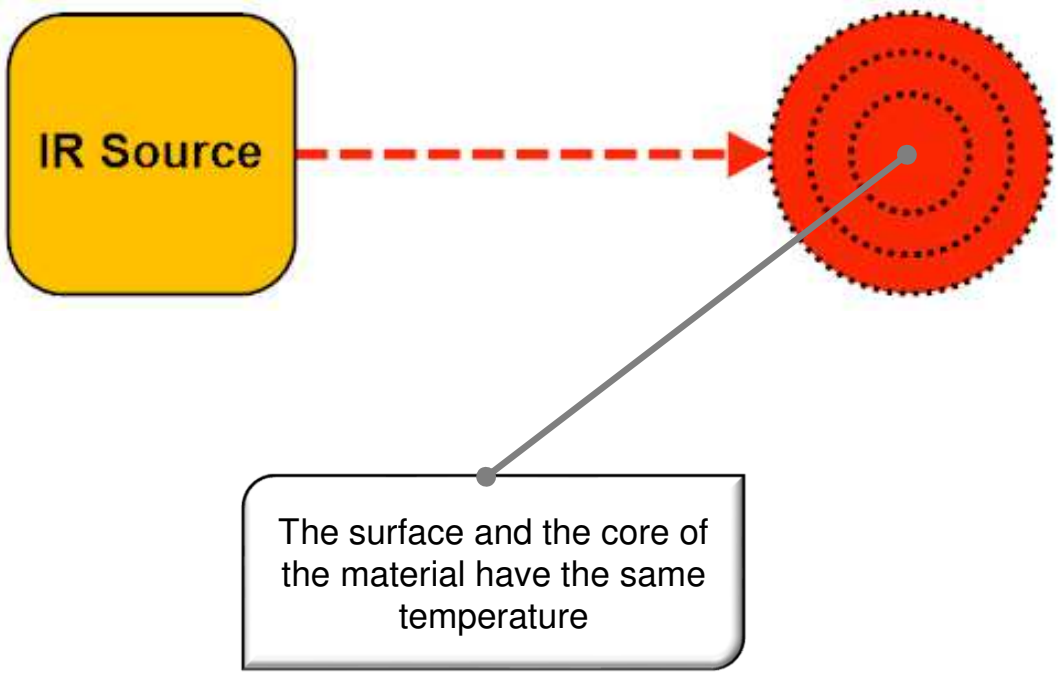


ADVANTAGES OF USING INFRARED AND VACUUM

BENEFIT NR 3

PET
POLYESTER

The infrared radiation heats the material directly, inside and in a uniform manner



At the end of the process, the treated material is in the same condition of temperature and humidity

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ADVANTAGES OF USING INFRARED AND VACUUM

PET
POLYESTER

BENEFIT NR 3

The combination of infrared with an ambient under vacuum

- Increases the quality of the crystallization
- Improves the yield of SSP

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ADVANTAGES OF USING INFRARED AND VACUUM

BENEFIT NR 4

PET
POLYESTER

Vacuum decreases the boiling point of water

The migration of water is anticipated by the vacuum

Operating close to the absolute vacuum, MOBY system can start the dehumidification from 80-85°C

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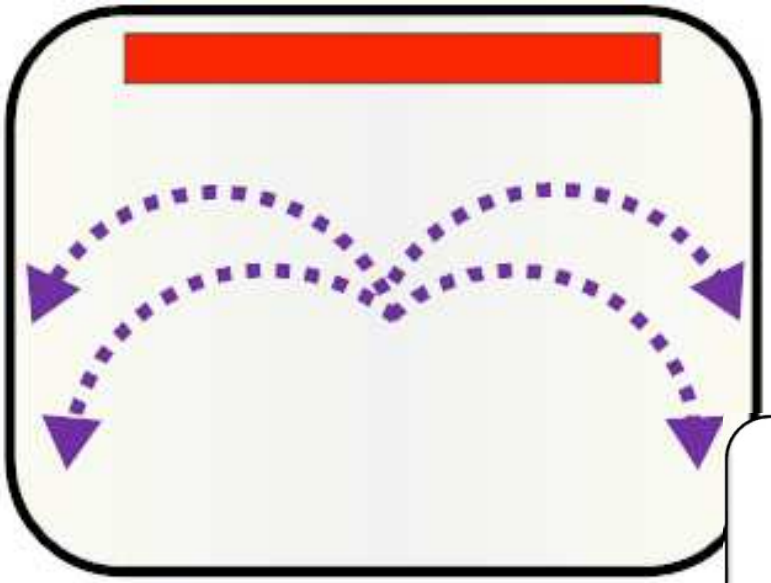
ADVANTAGES OF USING INFRARED AND VACUUM

BENEFIT NR 4

PET
POLYESTER

All the bodies under vacuum fall at the same speed



The lamps are protected from dust and pollution

By applying a known law of physics, the system MOBY is able to handle not only granules, but also regrinds having irregular shape, while keeping safe both the radiation and filtration means

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ADVANTAGES OF USING INFRARED AND VACUUM

BENEFIT NR 4

PET
POLYESTER

BENEFIT NR 4

The combination of infrared with an ambient under vacuum

- Allows to work with materials having irregular shapes
- Allows to process contaminated materials

Regrind of strap and thermoforming sheet in PET

Regrind of monofilament for brooms in PET+PE/PP

Regrind of sheet in PET+PE

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PET
POLYESTER

- INTRODUCTION TO MOBY SYSTEM
- ADVANTAGES OF USING INFRARED AND VACUUM
- **SOLID STATE POLYCONDENSATION (SSP) OF PET**
- SUPER-CLEAN OF PET
- EXAMPLES OF APPLICATIONS
- MOBY LAB

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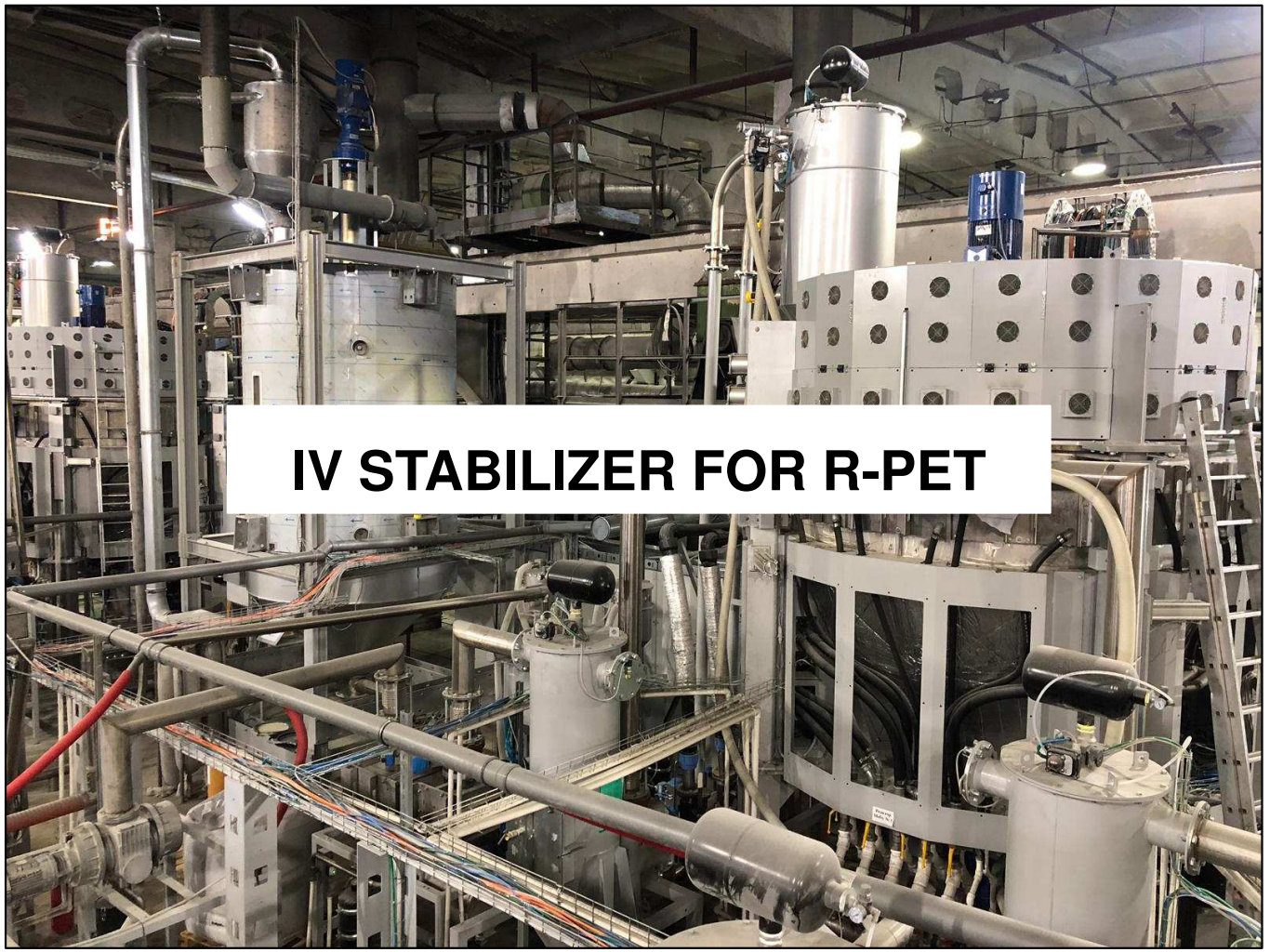
SOLID STATE POLYCONDENSATION (SSP) OF PET

PET
POLYESTER



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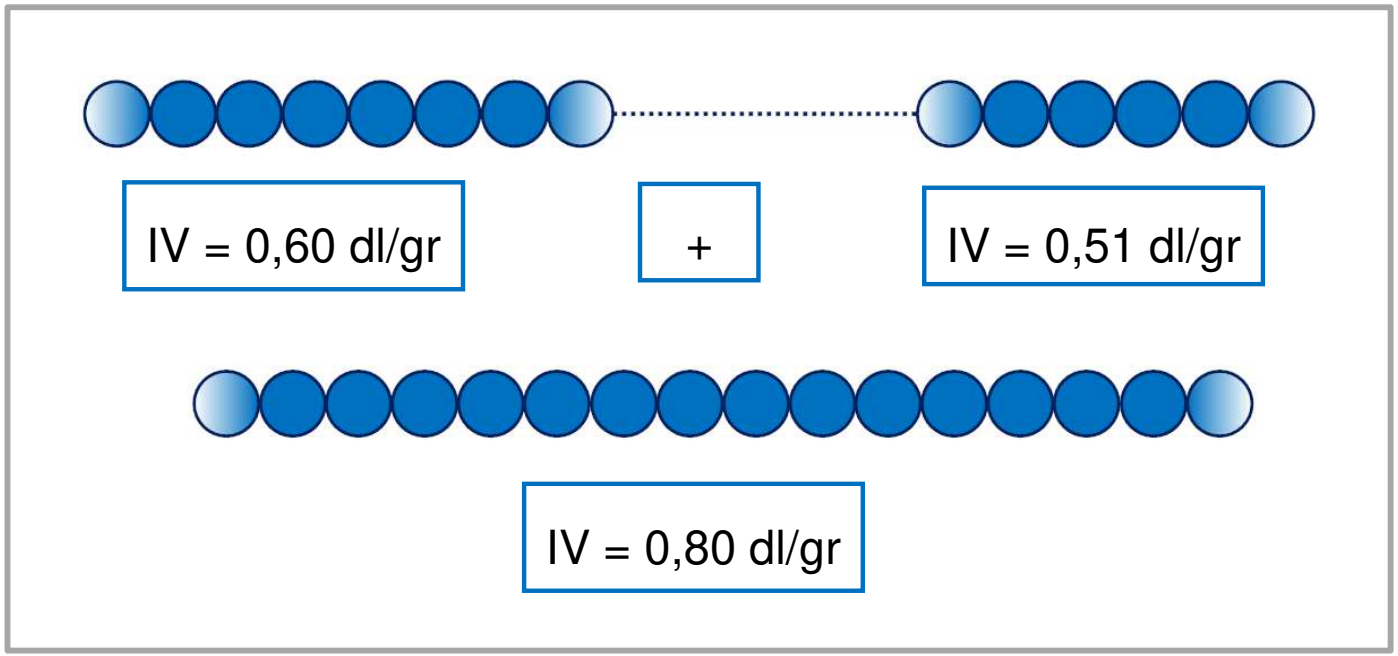
SOLID STATE POLYCONDENSATION (SSP) OF PET

PET
POLYESTER

PET - polyethylene terephthalate - is a polycondensation polymer which is obtained by reaction of terephthalic acid and ethylene glycol and water elimination



The SSP is a solid state polycondensation which improves the mechanical properties of PET

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SOLID STATE POLYCONDENSATION (SSP) OF PET

PET
POLYESTER

The conditions to operate an SSP of PET are:

Temperature >200°C

Absence of oxygen

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PET
POLYESTER

Why INFRARED RADIATIONS and VACUUM?

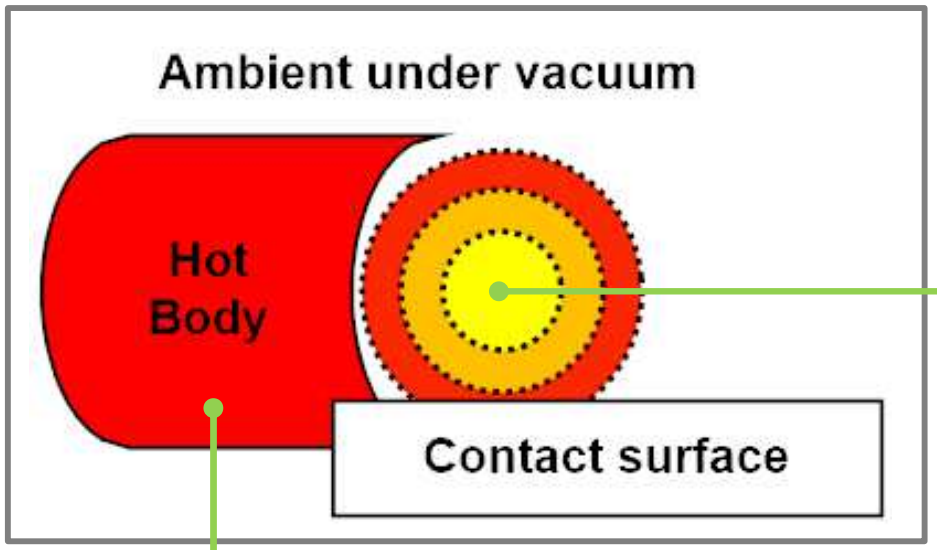
PET
POLYESTER

The combination of infrared with an ambient under vacuum solves some limitations of the known systems operating SSP of PET

SOLID STATE POLYCONDENSATION (SSP) OF PET

PET
POLYESTER

Limitations of an SSP heating by conduction



- Low efficiency (vacuum is an insulator)
- Long duration
- High costs of plants
- Non-uniform heating of material
- Limitations in the temperature of material

T Surface > T Inside

T Hot Body > T Material

T Max Hot Body = ~ 230-235°C

T Max Material = ~ 200-210°C

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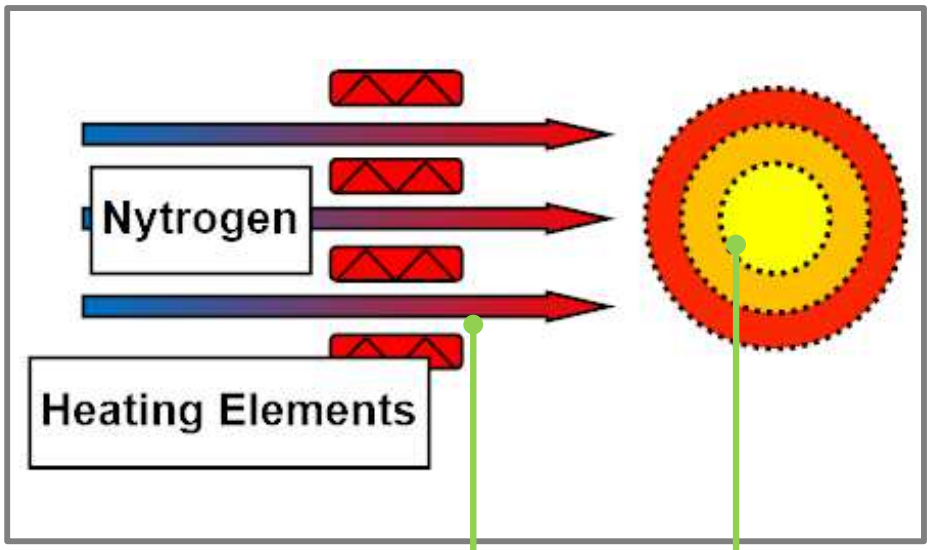
SOLID STATE POLYCONDENSATION (SSP) OF PET

PET
POLYESTER

Limitations of an SSP heating by convection



- Operation costs (production, dehumidification and recovery of the nytrogen)
- High costs of start-up and shutdown
- Non-uniform heating of material
- Limitations in the temperature of material

T Surface > T Inside

T Nytrogen > T Material

T Max Nytrogen = ~ 235-240°C

T Max Material = ~ 210-220°C

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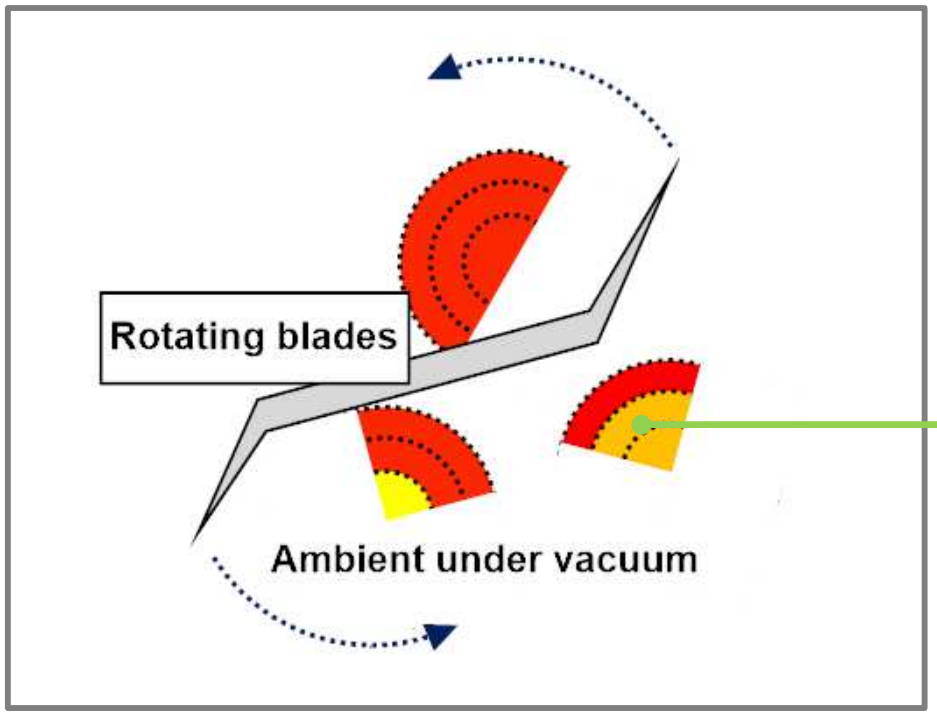
SOLID STATE POLYCONDENSATION (SSP) OF PET

PET
POLYESTER

Limitations of an SSP heating by friction



- Difficult control of temperature
- Non-uniform heating of material
- Creation of dust and crushing of the material

The material must be converted

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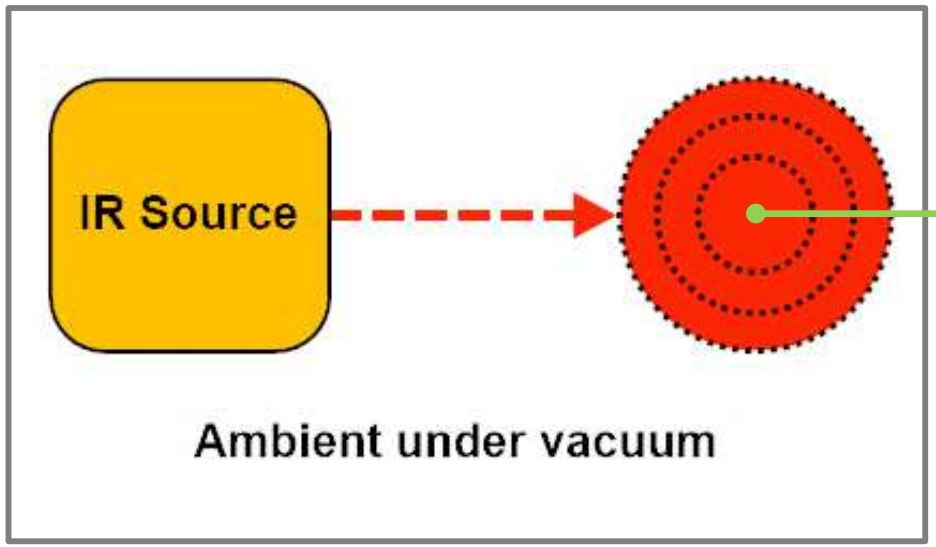
SOLID STATE POLYCONDENSATION (SSP) OF PET

PET
POLYESTER

SSP heating by radiations - MOBY



T Surface = T Inside

DIRECT HEATING

T Max Material = up to ~ 235°C

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Infrared radiations + Vacuum = Heating

- Direct
- Uniform
- Selective
- Fast

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SOLID STATE POLYCONDENSATION (SSP) OF PET

PET
POLYESTER

SSP heating by radiations - MOBY

The growth of the intrinsic viscosity of the PET under SSP is maximum and, above all, constant in time

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SOLID STATE POLYCONDENSATION (SSP) OF PET

PET
POLYESTER

The use of MOBY technology in the treatment of PET is particularly advantageous in terms of speed and flexibility, i.e.:

	SPEED	FLEXIBILITY
Crystallization and Dehumidification	1 h and 1/2 to move the humidity from 1% (10.000ppm) to 0.0005% (50ppm)	Material shape Contaminants (PE, PP, etc…)
Solid State Polycondensation (SSP)	IV rise-up range: - from a minimum of 0.026 dl/gr/h - to a max of 0.11 dl/gr/h	Materiale shape Contaminants (PVC)

(a) less cost of investment, (b) less energy consumption and (c) best R.O.I.

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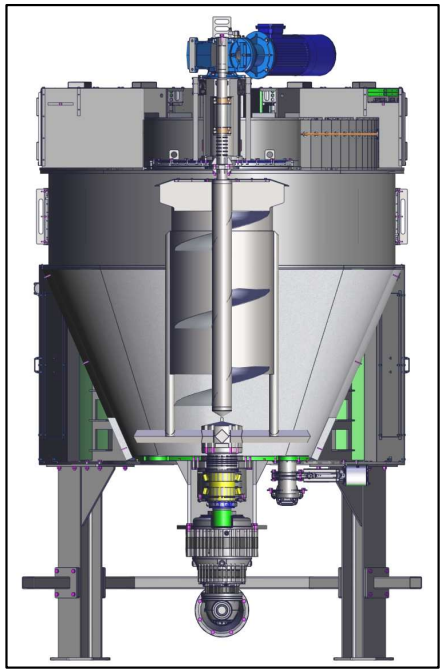
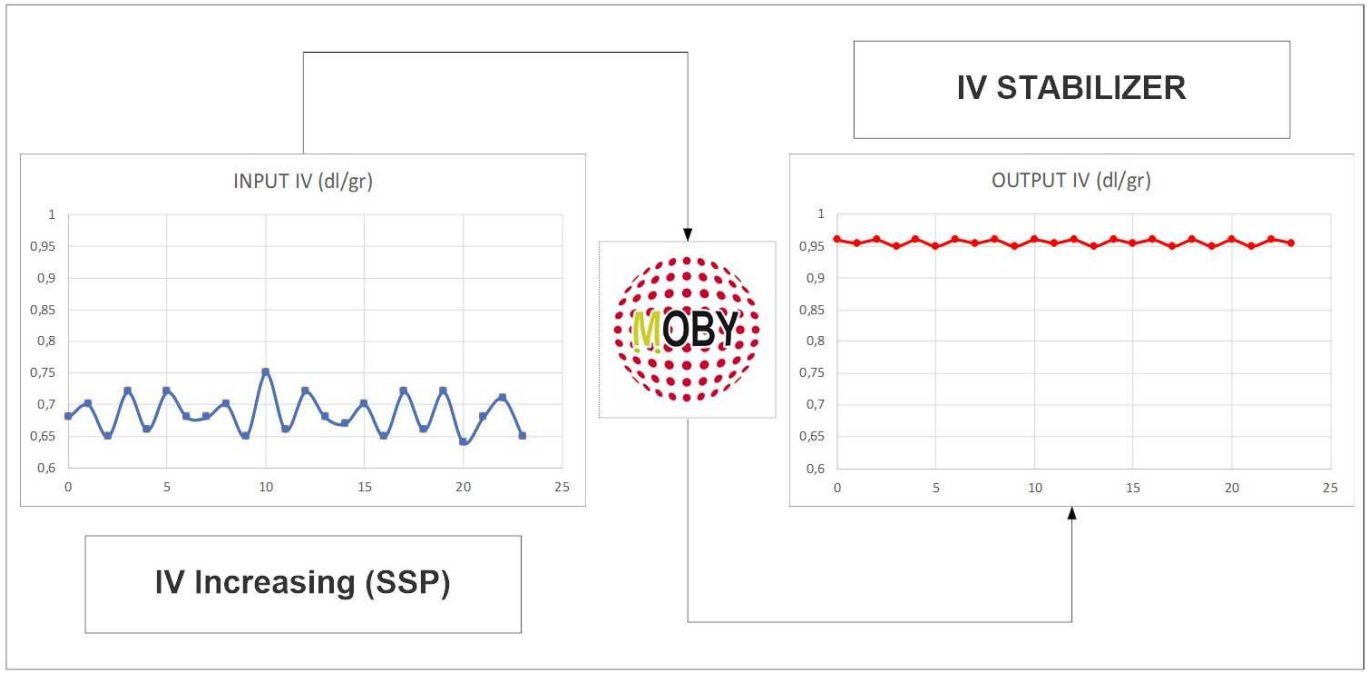
SOLID STATE POLYCONDENSATION (SSP) OF PET

PET
POLYESTER

R-PET - IV STABILIZER





The MOBY technology, thanks to the combination of infrared radiations, vacuum and prolonged mixing, works not only as an intrinsic viscosity enhancer (up to 1.3 dl/gr on bottle flakes), but also and above all as an IV STABILIZER.

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PET
POLYESTER

- INTRODUCTION TO MOBY SYSTEM
- ADVANTAGES OF USING INFRARED AND VACUUM
- SOLID STATE POLYCONDENSATION (SSP) OF PET
- **FOOD-CONTACT R-PET (SUPER-CLEAN)**
- EXAMPLES OF APPLICATIONS
- MOBY LAB

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SUPER-CLEAN OF PET

PET
POLYESTER

The so called “Super-Clean” is a kind of SSP operated at 200-210°C in which the residual chemical contaminants are removed in order to reuse the material in food applications

R-PET
(~ IV 0,70 dl/gr)

Food-
packaging

* The RPET must have specific properties in terms of color and contents of PVC, glue, aluminum, HDPE, PP and other polymer foreign particles. The end user must refer to local regulations for approval

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SUPER-CLEAN OF PET

PET
POLYESTER

«CHALLENGE TEST» FOR FOOD-CONTACT RECYCLING

The official tests carried out by the Fraunhofer-Institut für Verfahrenstechnik und Verpackung have shown that the infrared + vacuum technology MOBY is able to decontaminate the recycled polyester (R-PET) to make it again suitable for contact with food

«Cleaning efficiency» > 99%
Both on R-PET in flakes
and R-PET in granules

FDA approved

With letters «PNC 1442 e 1443»

Categories of FDA «food-contact» : from «B» to «H»

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PET
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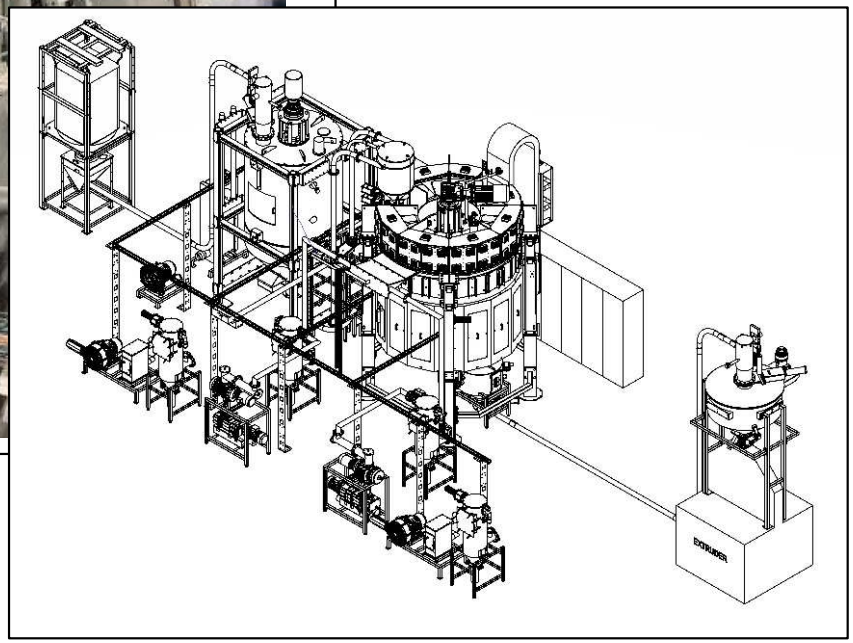
EXAMPLES OF APPLICATIONS

PET
POLYESTER



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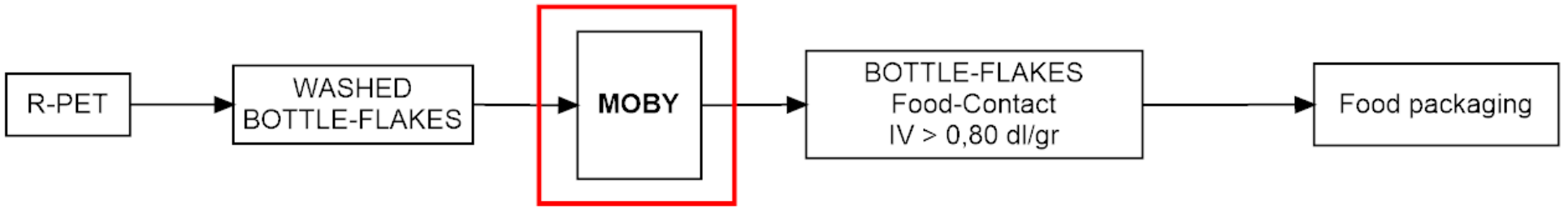
EXAMPLES OF APPLICATIONS

PET
POLYESTER

BOTTLE-TO-BOTTLE (B2B)



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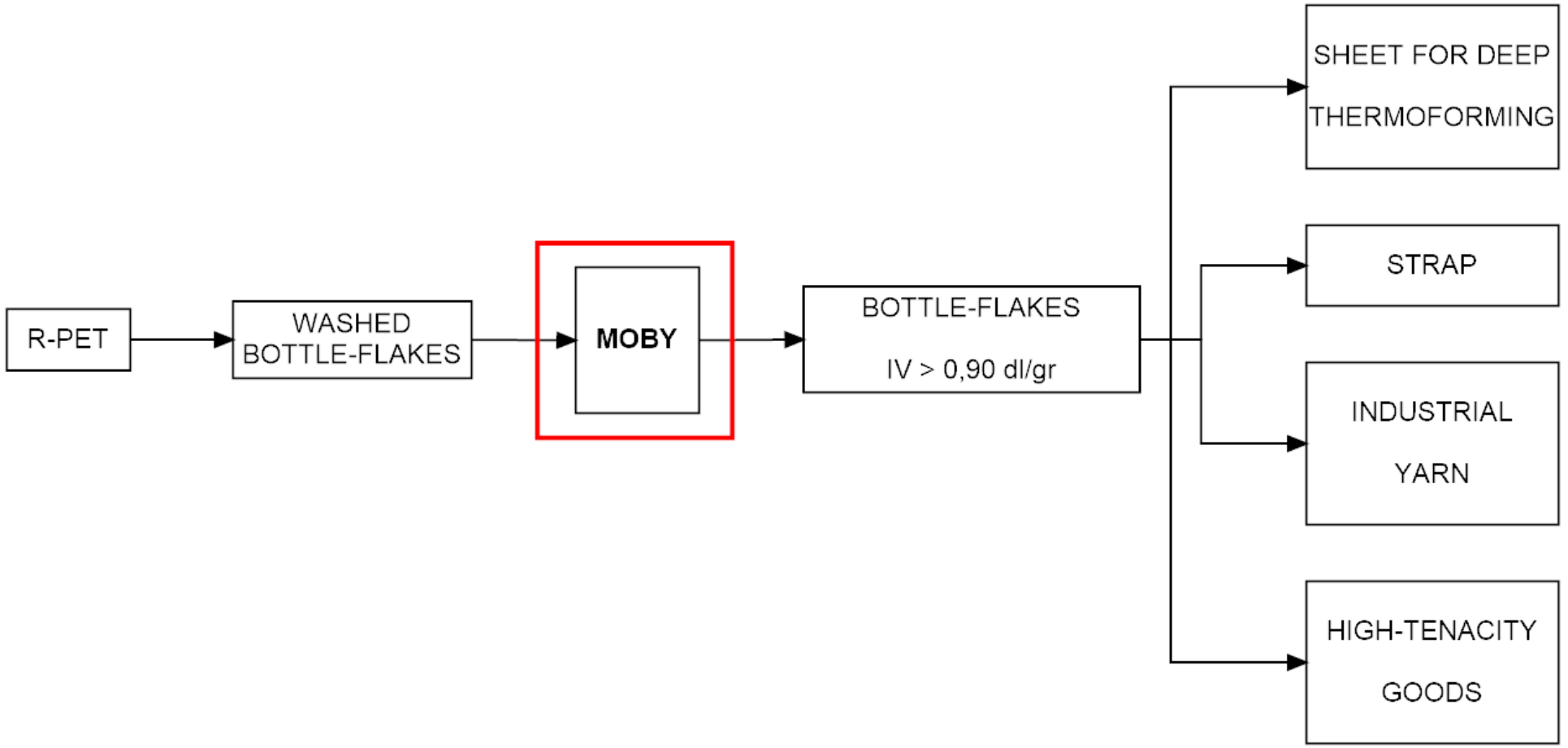
EXAMPLES OF APPLICATIONS

PET
POLYESTER

RECYCLING FOR HIGH-TENACITY APPLICATIONS



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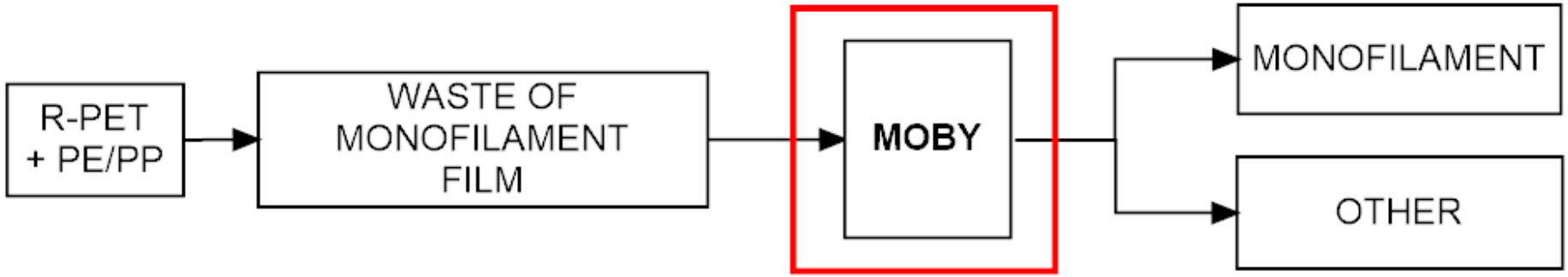
EXAMPLES OF APPLICATIONS

PET
POLYESTER

RECYCLING OF PET POLLUTED BY PE/PP



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EXAMPLES OF APPLICATIONS

PET
POLYESTER

PRODUCTION FROM 50 TO OVER 2.500 Kg/h

BOTTLE-TO-BOTTLE (B2B)

RECYCLING FOR HIGH-TENACITY APPLICATIONS

RECYCLING OF PET POLLUTED BY PE/PP

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EXAMPLES OF APPLICATIONS

PET
POLYESTER

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PET
POLYESTER

- INTRODUCTION TO MOBY SYSTEM
- ADVANTAGES OF USING INFRARED AND VACUUM
- SOLID STATE POLYCONDENSATION (SSP) OF PET
- SUPER-CLEAN OF PET
- EXAMPLES OF APPLICATIONS
- **MOBY LAB**

MOBY

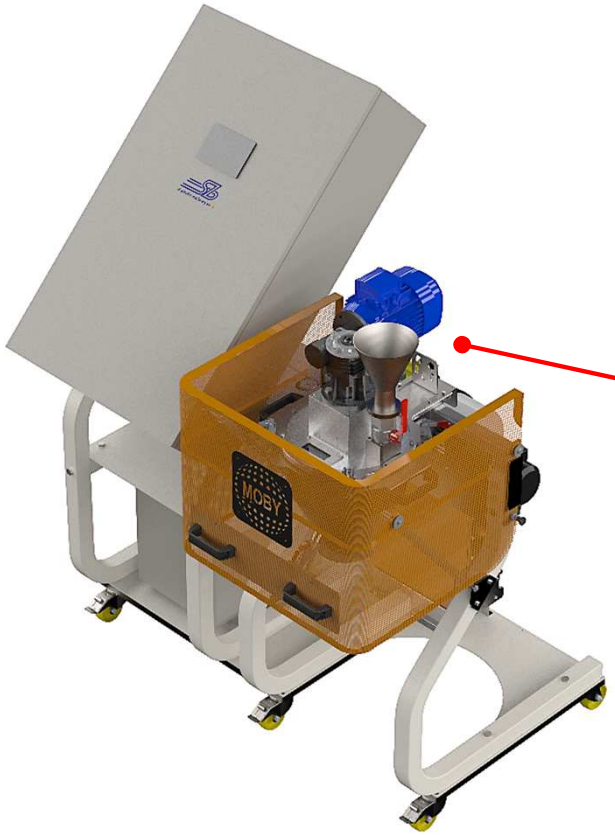
sb plastics machinery

MOBY LAB

PET
POLYESTER

MOBY LAB reproduces on a small scale the same process
with infrared radiations and vacuum of an industrial plant

- ✓ TO START
- ✓ TO UNDERSTAND
- ✓ TO TRY



5-10 LTs BATCH

SOLID STATE POLYCONDENSATION FOR LABORATORY

MOBY

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07237
서울시 영등포구 국회대로 68길 23
정원빌딩 309호
TEL : 02-2654-6049
FAX : 02-6347-7212
Mobile : 010-9120-7212
E-mail : kskim2020@gmail.com