

**BANDERA**  
EXTRUSION INTELLIGENCE®

# UPCYCLING

BE PART OF THE PLASTIC CHANGE

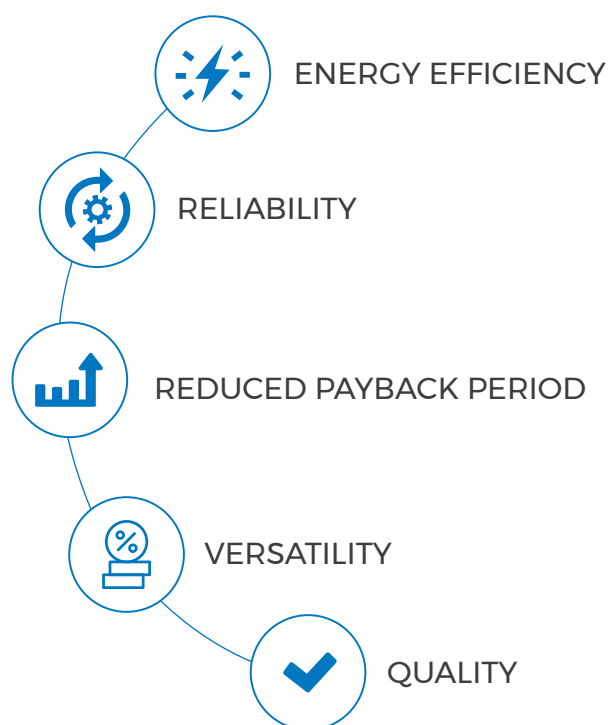
EXTRUSION TECHNOLOGIES  
**FOR UPCYCLING APPLICATIONS**



# UP-CYCLING

Bandera Recycling Technologies are the definitive answer to the growing demand for recycled extruded plastics, with the same range of quality and quantity of traditional raw material.

**Recyclate becomes a new raw material**, for a high-end result with high added value.



## BANDERA areas of expertise in RECYCLING



**01**

IN-HOUSE  
FLEXIBLE FILM



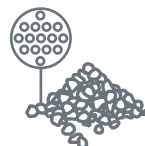
**02**

POST-CONSUMER  
POLYOLEFIN



**03**

VOCs & ODOUR  
REMOVAL



**04**

PET  
(PIR & PCR)



**05**

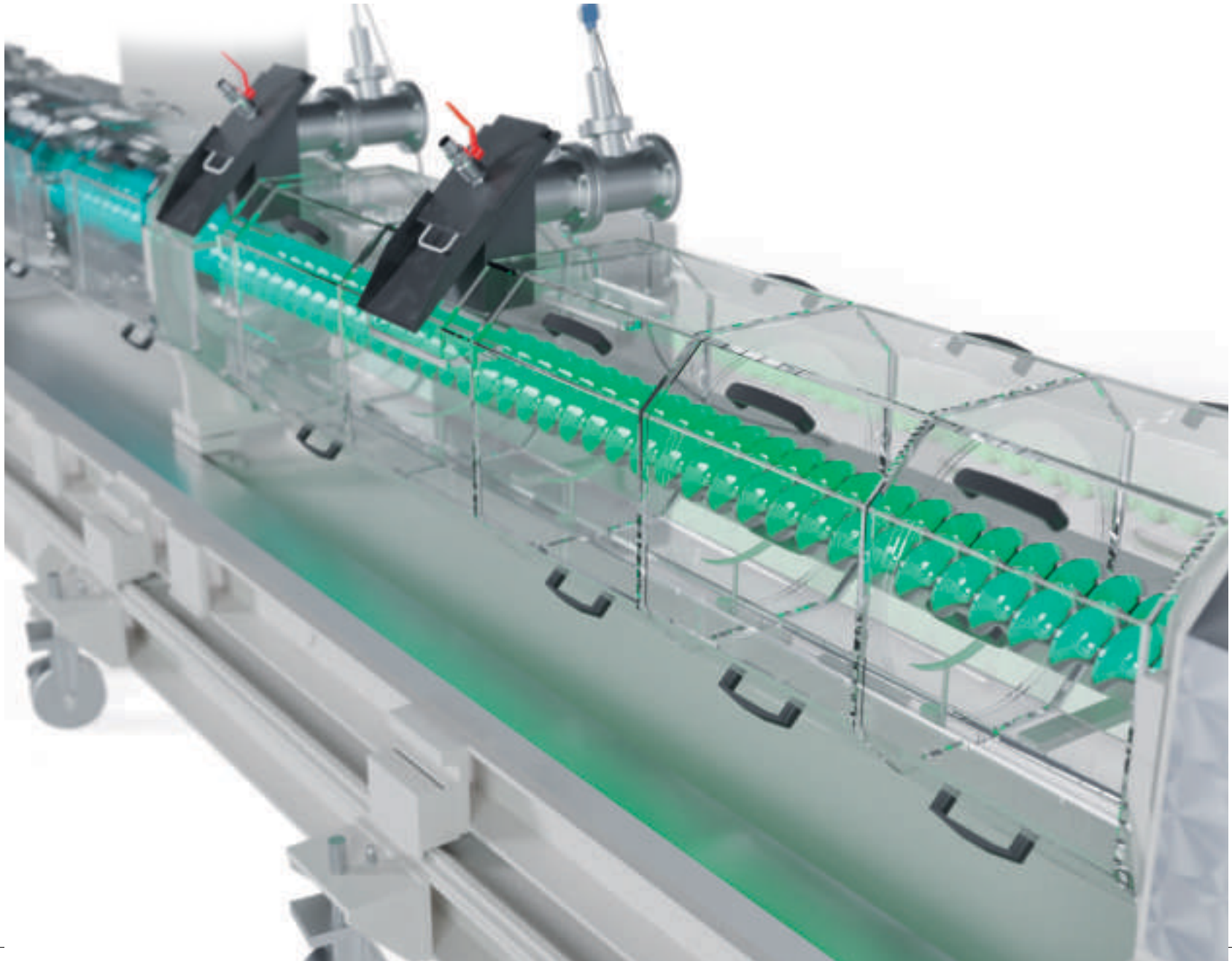
BOTTLE-TO-BOTTLE

# TW INTELLIGENCE<sup>®</sup> \*

## Co-rotating twin screw

The best technology on the market to enhance the characteristics of the starting material.

Bandera recycling technologies can process post-industrial and/or post-consumer waste to obtain a recycled polymer with quality and purity comparable to virgin (up-cycling), with the possibility of including also special features such as mineral fillers or fibers.





# Extruding Future Plastics Now®\*



# 01

## IN-HOUSE FLEXIBLE FILM

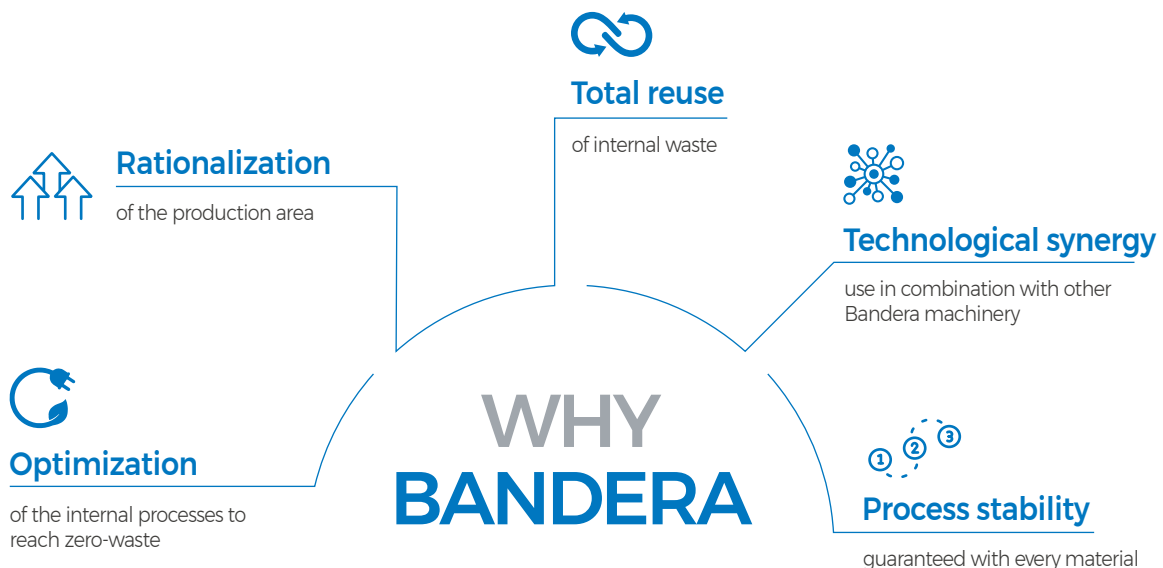
### Technology

Bandera's product range for in-house recycling is based on the experience and leadership gained from over 70 years of excellence in the field of extrusion of plastics for packaging and converting.

From this synergy comes the recycling technology strongly oriented to the quality of the final product.

### Aim

Offer in-line and off-line solutions for industrial waste resulting from trimming/contouring, line production change, quality control.





## TRIM FLEX®\*

- In-line solution for trimming operation
- Output up to:
 

|          |         |
|----------|---------|
| 176 lb/h | 80 kg/h |
|----------|---------|
- Counter-rotating twin screw technology
- Possibility of use in synergy with Bandera Blown Film/cast line



## REEL FLEX®\*

- Off-line solution for faulty reels and production waste
- Output up to:
 

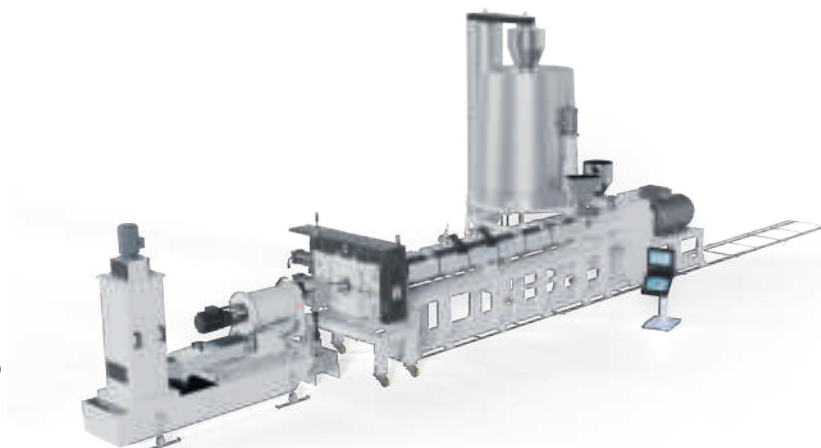
|          |          |
|----------|----------|
| 330 lb/h | 150 kg/h |
|----------|----------|
- Counter-rotating twin screw technology



## The machines

### TWIN® PIR

- Up-cycling line
- Extruder with co-rotating twin screw for the recovery of waste of Blown Film and cast lines
- Recovery and reuse up to 100% of production waste

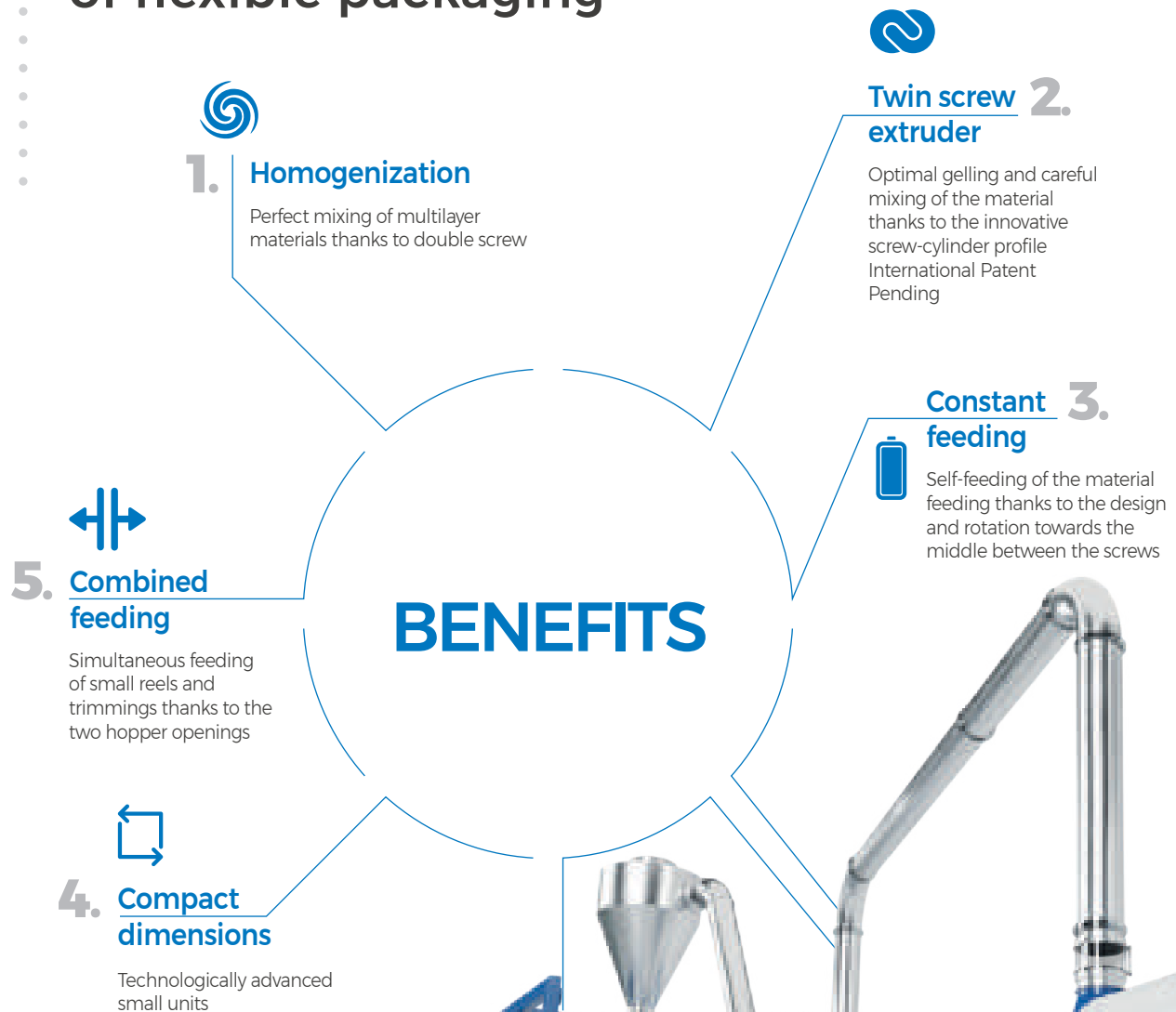


## Raw materials

| Product     | Biobased plastics | Lightly printed film | Edge trim<br>(e.g. PE/PA/<br>EVOH) | BOPP film | Multiple layer film reels<br>(e.g. PE/PA/EVOH) | PP non woven | PE crosslinked film | PP sacking/<br>raffia |
|-------------|-------------------|----------------------|------------------------------------|-----------|------------------------------------------------|--------------|---------------------|-----------------------|
| Trim FLEX®* | X                 |                      | X                                  |           |                                                |              |                     |                       |
| Reel FLEX®* | X                 | X                    |                                    |           | X                                              | X            |                     |                       |
| TWIN® PIR   | X                 | X                    |                                    | X         | X                                              | X            | X                   | X                     |

# TRIM FLEX<sup>®</sup>\* i61/i72

Trim FLEX<sup>®</sup>\* comes from in-depth knowledge of flexible packaging



**MATERIALS**

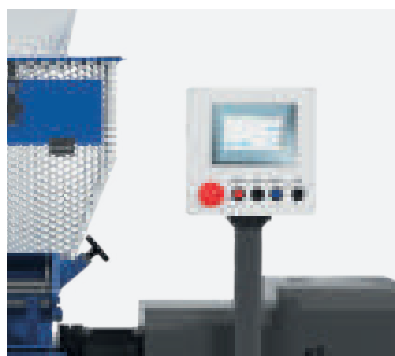
- Bioplastic
- Edge trim (PE/PA/EVOH)

**SIZES**

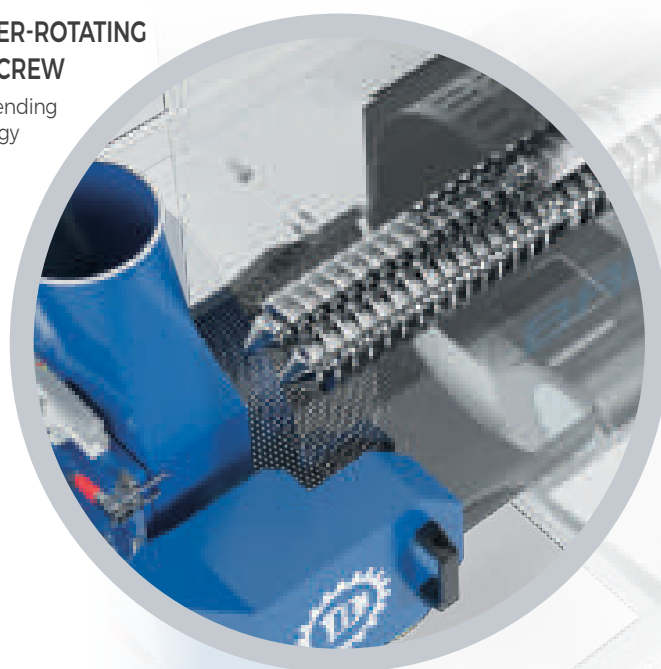
- Trim **FLEX®** i61 up to: 

|         |         |
|---------|---------|
| 88 lb/h | 40 kg/h |
|---------|---------|
- Trim **FLEX®** i72 up to: 

|          |         |
|----------|---------|
| 176 lb/h | 80 kg/h |
|----------|---------|

**LINE SUPERVISOR SYSTEM ANY MA®****AIR CUTTING SYSTEM****COUNTER-ROTATING  
TWIN SCREW**

Patent Pending  
Technology

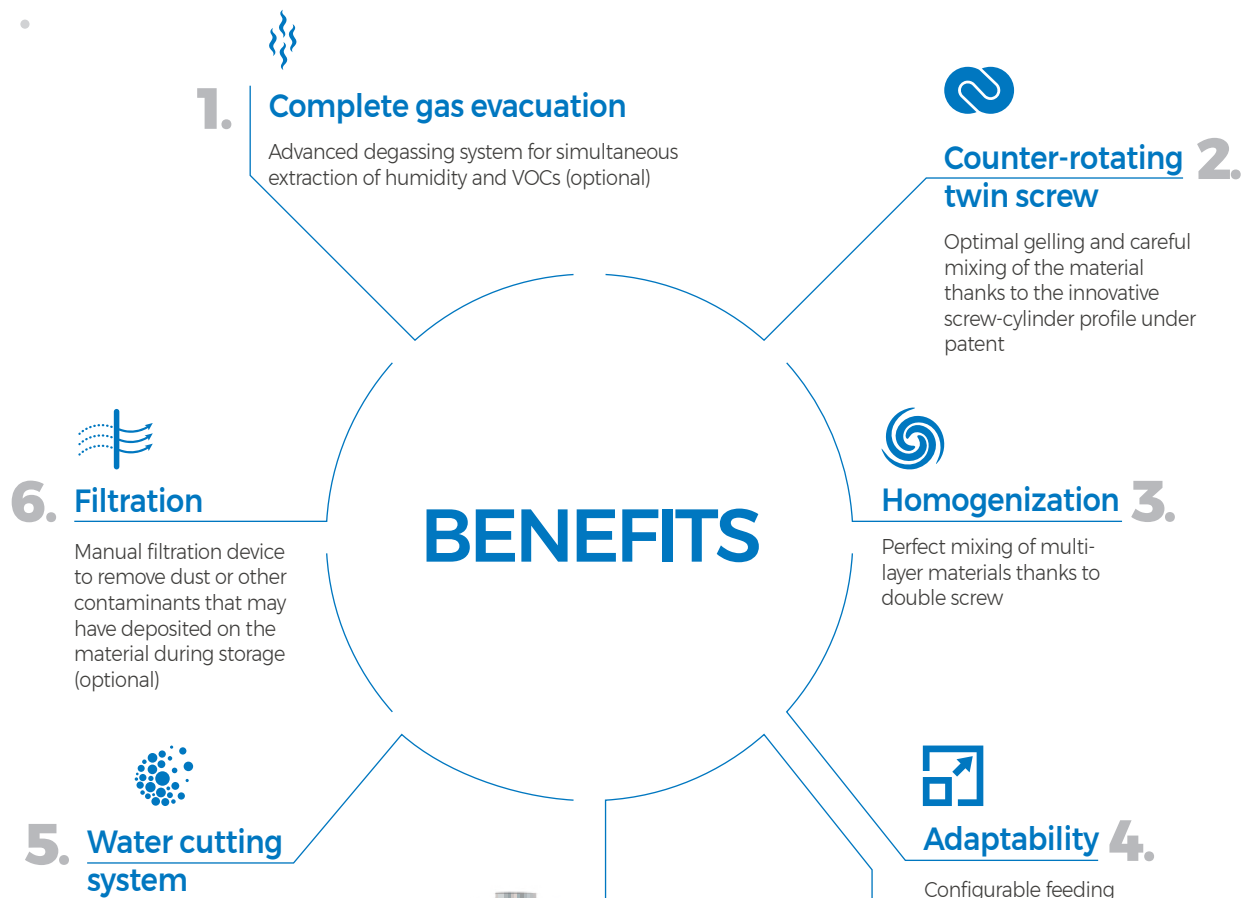




## Compact and flexible unit for recycling

Reel **FLEX**<sup>®</sup> has been specially designed for complex productions where the quantity of lines implies a high accumulation of production waste.

It is a very flexible solution that adapts to any form of plastic waste solving the disposal problems.



**FEEDING SYSTEMS**

- Forcing silo with horizontal auger
- Inclined auger feed for rigid materials
- Direct feeding

**MATERIALS**

- Biobased plastics
- Lightly printed film
- Multiple layer film reels (e.g. PE/PA/EVOH)
- PP non-woven

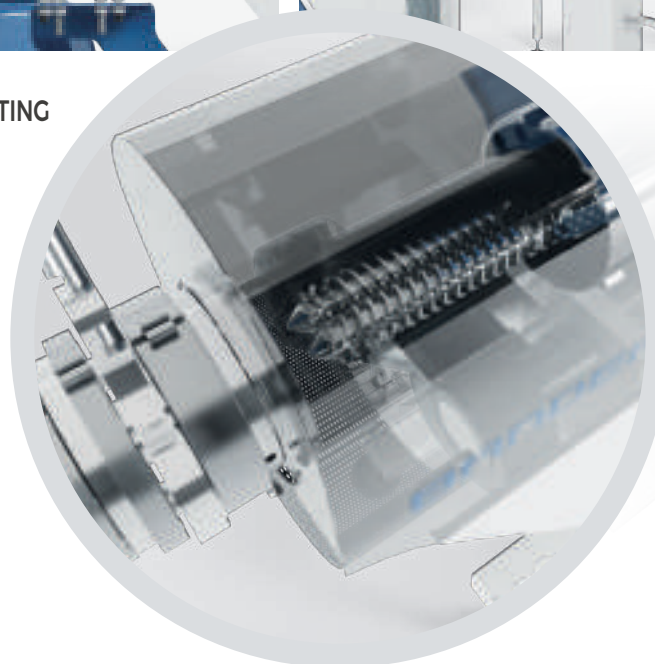
**SIZES**

- Reel **FLEX®** up to: 

|          |          |
|----------|----------|
| 330 lb/h | 150 kg/h |
|----------|----------|

**WATER CUT****FEEDING SYSTEM****COUNTER-ROTATING TWIN SCREW**

Patent Pending  
Technology



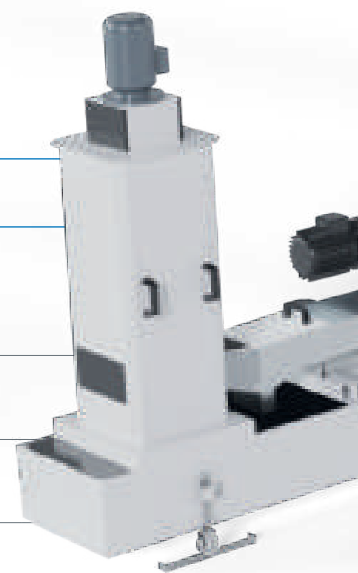
## Recovery and up-cycling of industrial waste

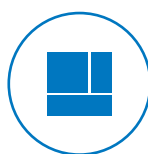
The Bandera co-rotating system is able to reprocess up to 100% of waste and convert it into a product with high added value, not dissimilar from the raw material. This system is particularly recommended for the recovery of technical films (cross-linked) or barrier multi-material films (PE/PA/EVOH).



### Comparison

| Product                     | Single screw                                                                                                                           | Twintelligence®*                                                                                                            |
|-----------------------------|----------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|
| Multi material (PE/PA/EVOH) | <ul style="list-style-type: none"> <li>Inhomogeneity</li> <li>Processable in low %</li> <li>Burn marks on the final product</li> </ul> | <ul style="list-style-type: none"> <li>High homogenization degree</li> <li>Gas evacuation</li> <li>100% reusable</li> </ul> |
| Barrier with EVOH           | <ul style="list-style-type: none"> <li>Black spots</li> <li>Residue on the screw</li> </ul>                                            | <ul style="list-style-type: none"> <li>Self-cleaning screws</li> <li>Low shear stress: no degradation</li> </ul>            |
| Cross-linked film           | <ul style="list-style-type: none"> <li>Not processable</li> <li>Non-recoverable</li> </ul>                                             | <ul style="list-style-type: none"> <li>Processable</li> <li>Up to 50% reusable</li> </ul>                                   |



**OPTIONAL**

- Grinder
- Silo-Buffer
- Oil cooled extruder
- Water cooled engine
- Melt pump
- Vibrating screen for granule cooling & separation
- Granule storage

**MATERIALS**

- Bioplastic
- Lightly printed
- BOPP film
- Multiple Layer film
- PP non-woven
- PP sacking /raffia
- PE crosslinked-film

**SIZES**

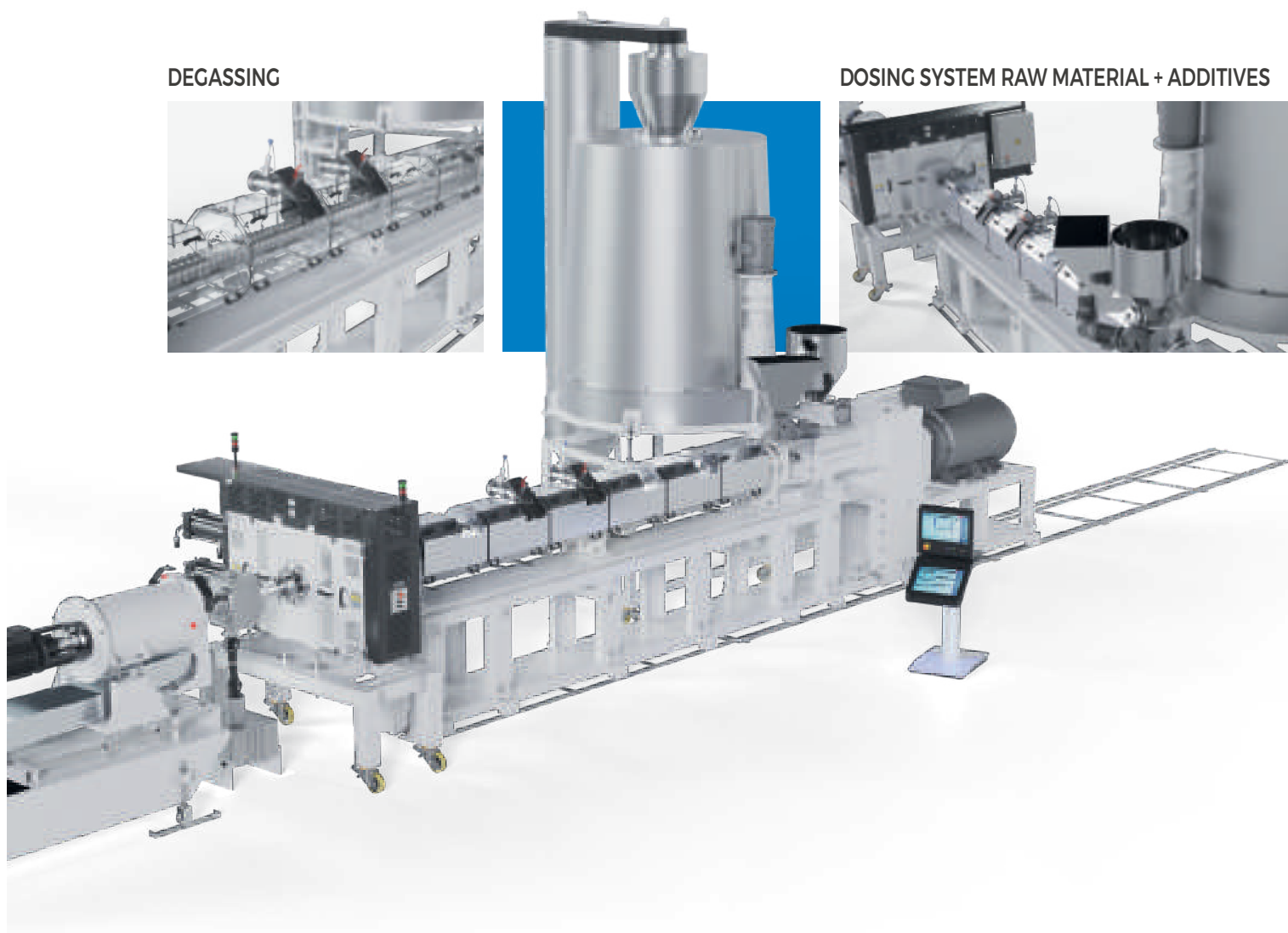
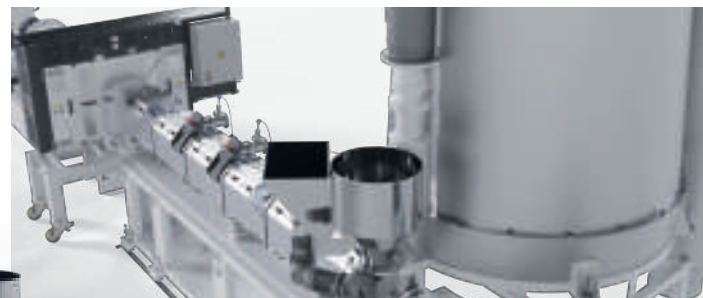
- **TWIN®** PIR 70: 

|              |              |
|--------------|--------------|
| 330-661 lb/h | 150-300 kg/h |
|--------------|--------------|
- **TWIN®** PIR 85: 

|               |              |
|---------------|--------------|
| 771-1322 lb/h | 350-600 kg/h |
|---------------|--------------|
- **TWIN®** PIR 105: 

|                |               |
|----------------|---------------|
| 1433-2204 lb/h | 650-1000 kg/h |
|----------------|---------------|
- **TWIN®** PIR 135: 

|                |                |
|----------------|----------------|
| 2425-3307 lb/h | 1100-1500 kg/h |
|----------------|----------------|

**DEGASSING****DOSING SYSTEM RAW MATERIAL + ADDITIVES**



02

## PCR POLYOLEFINS

In post-consumer recycling, the flexibility of the Bandera equipment allows to manage heterogeneous materials, even non-noble, producing high added value granules.

Bandera meets the specific needs of this sector with solutions that combine flexibility, stability, reliability and high flow rates to improve economies of scale and energy efficiency.



### 2. Equipment flexibility

Thanks to the technical properties of the equipment, heterogeneous and less noble sources of material can be processed while still delivering a granule with high added value



### 1. Vision change

Up-cycling instead of simple re-cycling. Recyclate becomes a new secondary raw material



### High profitability 3.

Top quality granule and reduced energy consumption for maximum optimization of the production process

WHY  
BANDERA



## TWIN® PCR

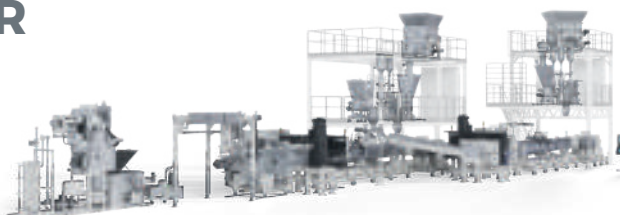
- Simple and versatile equipment, able to adapt to all forms of polyolefin waste; the ideal tool even for companies that have just entered the world of recycling
- Twintelligence® technology with capacity up to:

|           |           |
|-----------|-----------|
| 6613 lb/h | 3000 kg/h |
|-----------|-----------|



## TWIN® TANDEM PCR

- Customizable and flexible equipment, able to obtain a real secondary raw
- Twin screw cascade technology with high capacities



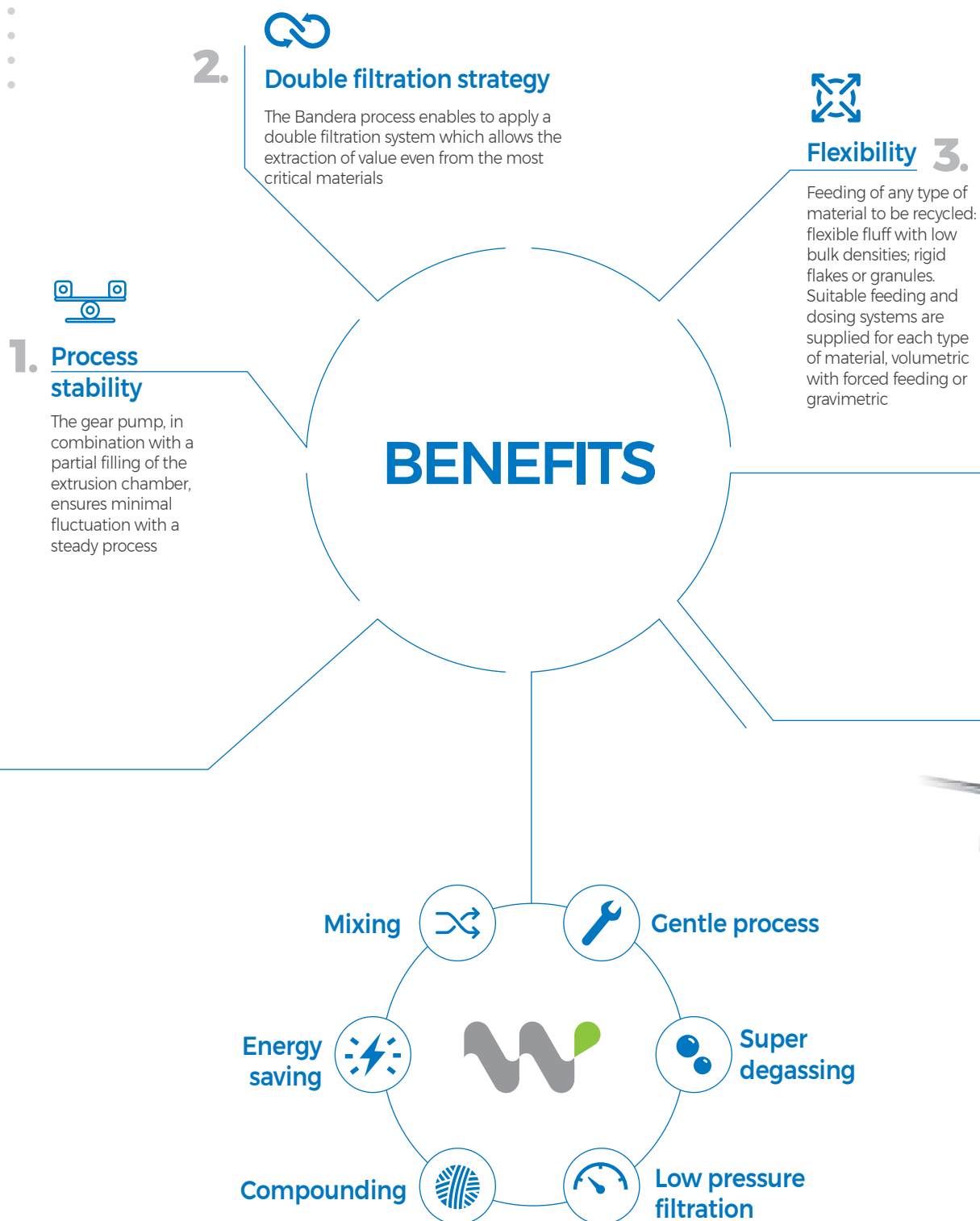
The lines

Raw materials

| Product          | HDPE PCR | PC/ABS PCR<br>(e.g. automotive or WEEE) | PP PCR | PS PCR | Heavily printed metalised | Heavily contaminated | Flexible film PCR<br>(e.g. Agri & Geo) |
|------------------|----------|-----------------------------------------|--------|--------|---------------------------|----------------------|----------------------------------------|
| TWIN® PCR        | X        | X                                       | X      | X      |                           |                      | X                                      |
| TWIN® TANDEM PCR | X        | X                                       | X      | X      | X                         | X                    | X                                      |

## Smart solution for treating polyolefins

Solution that allows processing the blends of heterogeneous materials while maintaining all the original characteristics unaltered. Ideal equipment for the production of premium materials.



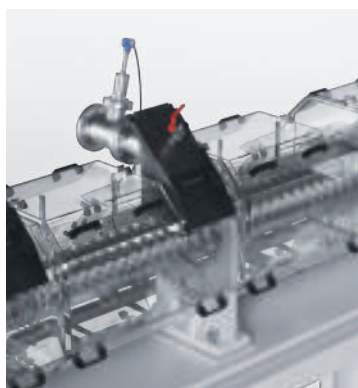


ADDITIONAL  
TWIN  
SCREW  
FOR  
COMPOUND



#### MATERIALS

- HDPE PCR
- PC/ABS PCR  
(e.g. automotive or WEEE)
- PP PCR
- PS PCR
- Flexible film PCR  
(e.g. Agri & Geo)



DEGASSING  
SYSTEM FOR  
ODOUR  
REMOVAL

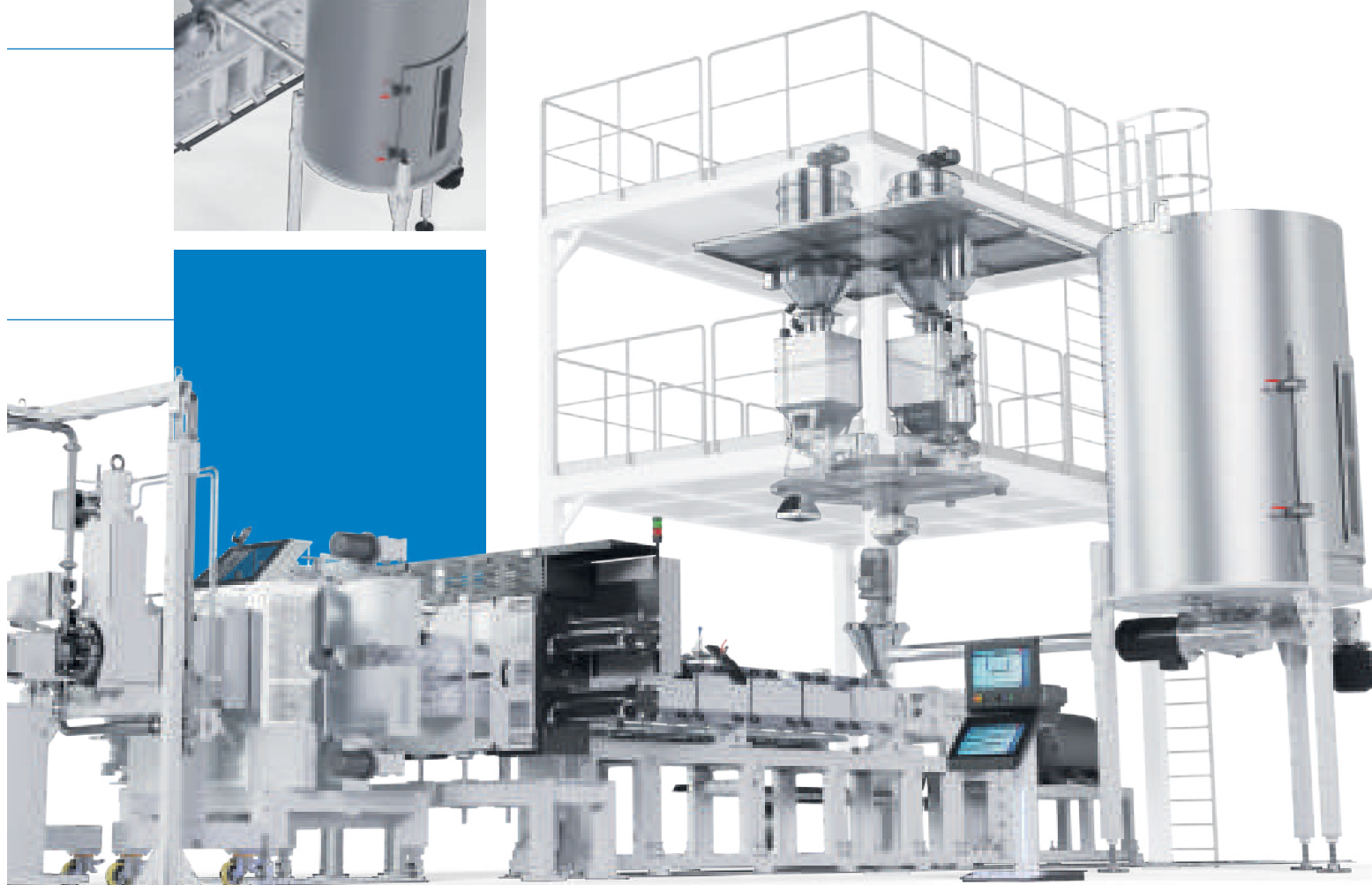
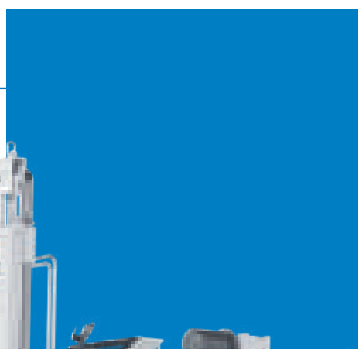


#### SIZES

- **TWIN®** PCR 105 capacity:  
1433-2204 lb/h | 650-1000 kg/h
- **TWIN®** PCR 135 capacity:  
2425-4409 lb/h | 1100-2000 kg/h
- **TWIN®** PCR 170 capacity:  
4629-6613 lb/h | 2100-3000 kg/h



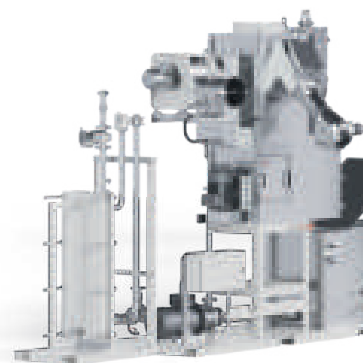
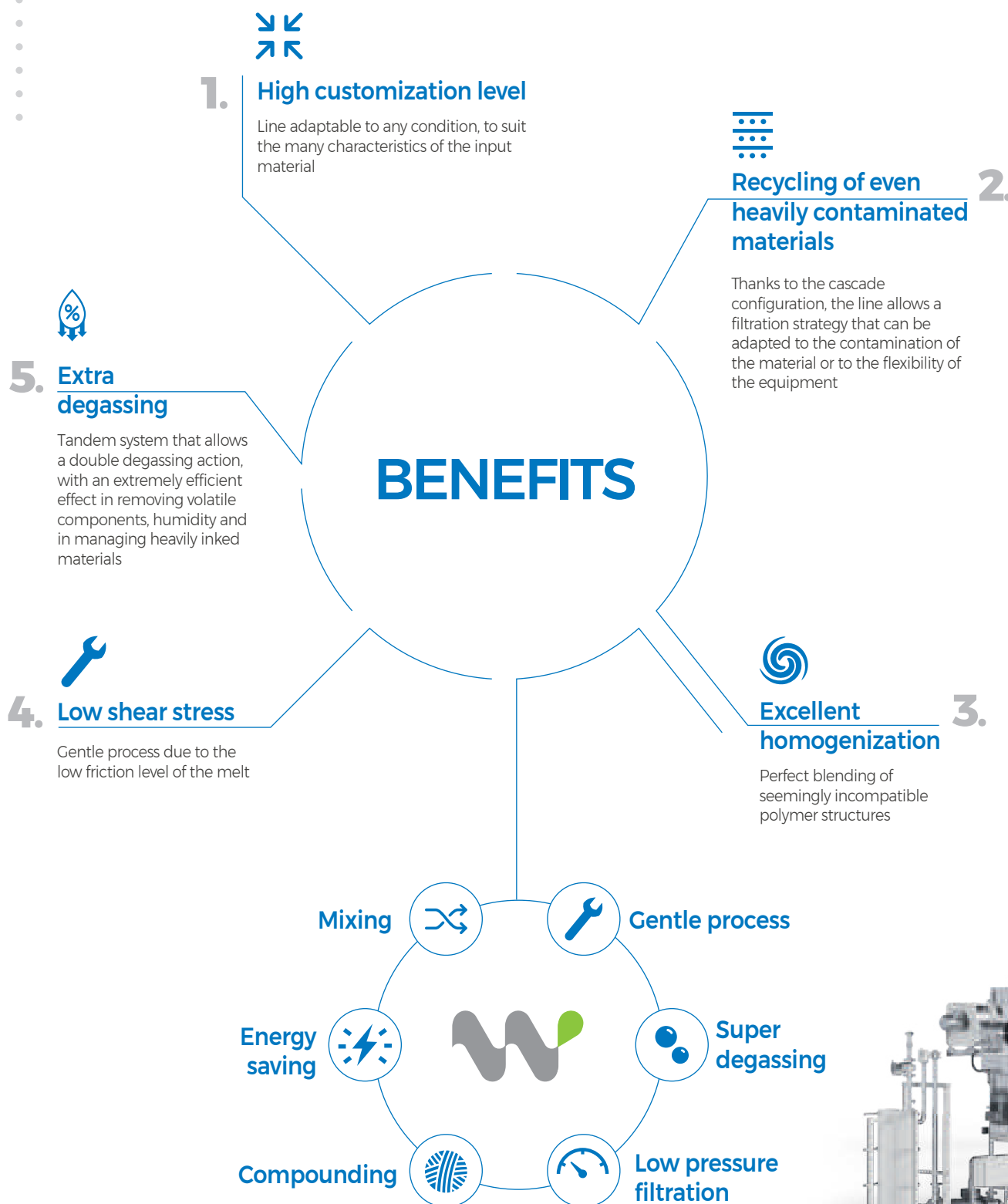
DOSING SYSTEM  
FOR CONSTANT AND  
STABLE RECIPES



# TWIN®\* TANDEM PCR

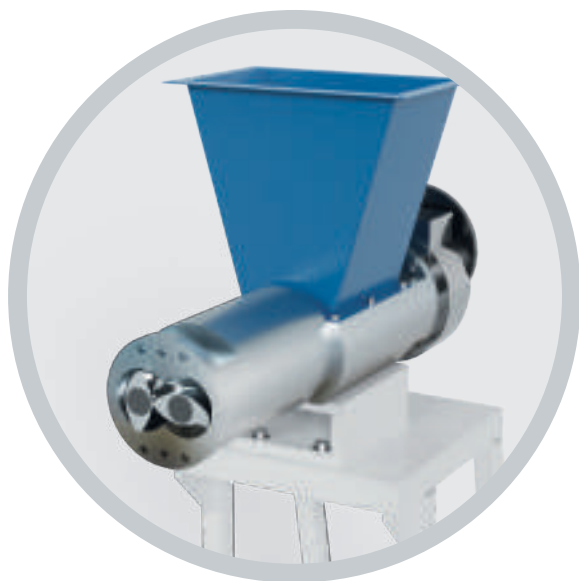
## Top solution for treating polyolefins

Solution with the highest technological contribution: a pair of co-rotating twin screws working in "cascade" mode, with a double dosing station and lateral feeders for adding new materials.





### ADDITIONAL TWIN SCREW FOR COMPOUND



#### MATERIALS

- HDPE PCR
- PC/ABS PCR  
(e.g. automotive or WEEE)
- PP PCR
- PS PCR
- Heavily printed metalised
- Heavily contaminated
- Flexible film PCR  
(e.g. Agri & Geo)



#### SIZES

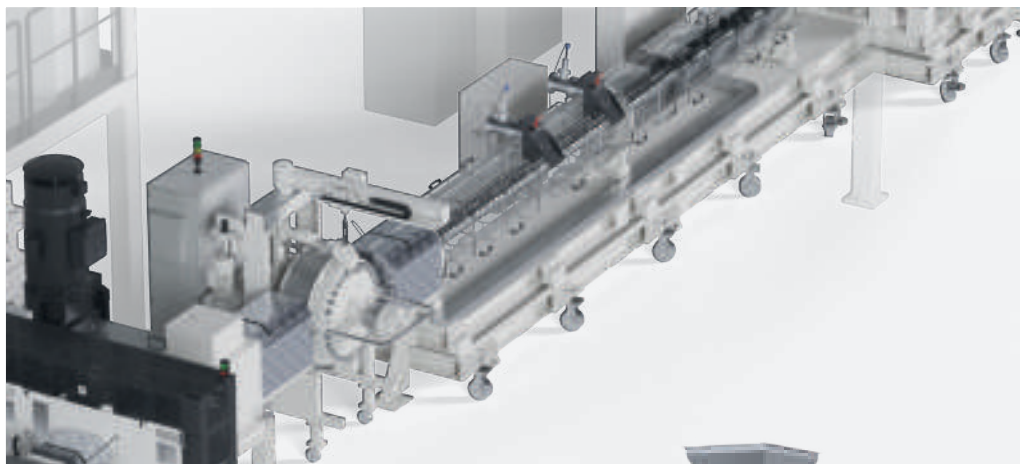
- **TWIN®** TANDEM PCR 105: 

|                |               |
|----------------|---------------|
| 1433-2204 lb/h | 650-1000 kg/h |
|----------------|---------------|
- **TWIN®** TANDEM PCR 105: 

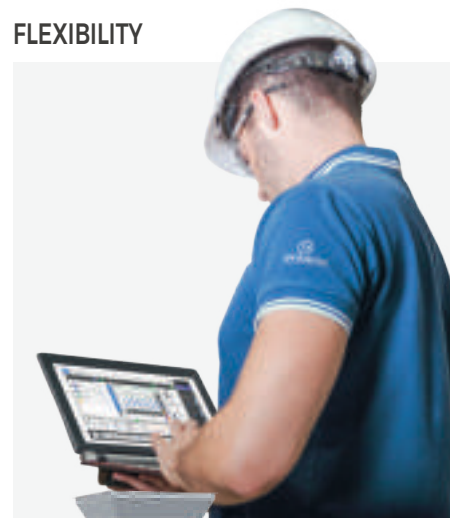
|                |                |
|----------------|----------------|
| 2425-4409 lb/h | 1100-2000 kg/h |
|----------------|----------------|
- **TWIN®** TANDEM PCR 105: 

|                |                |
|----------------|----------------|
| 4629-6613 lb/h | 2100-3000 kg/h |
|----------------|----------------|

### CUSTOMIZATION



### FLEXIBILITY



# 03

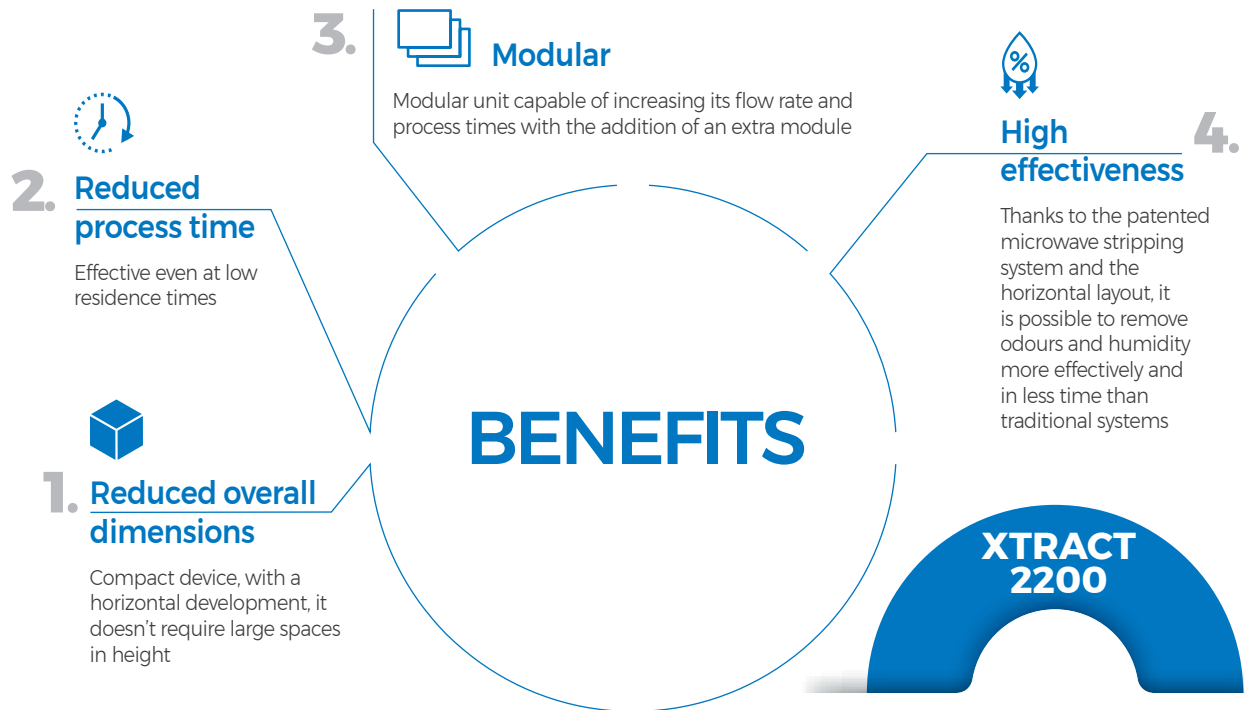
## XTRACT

### New life to the PCR pellet

Heterogeneous materials and contaminations can compromise the quality of the extruded granule due to the accumulation of unwanted materials on the filter, leading to the development of by-products and bad odour.

Up-cycling: Bandera has developed a system for the removal of humidity and volatile organic compounds through a patented microwave system that acts on the pellet, thus obtaining a secondary raw material suitable for even the most demanding industries.

The process is able to work in-line and off-line to optimize work times and reduce machine downtime.



### MICROWAVES VS VOCs & ODOUR

The patented revolutionary Bandera technology is based on the concept of stripping, which is performed by a series of micro-wave devices that can affect in an extremely specific way only the undesirable molecules. This causes such molecules to separate from the pellets, so that they can be effectively carried away by a counter-current flow of hot air.



| Modules | Capacity<br>2 h        | Capacity<br>4 h       | Capacity<br>6 h       |
|---------|------------------------|-----------------------|-----------------------|
| 1       | 3174 lb/h<br>1440 kg/h | 1587 lb/h<br>720 kg/h | 1058 lb/h<br>480 kg/h |



| Modules | Capacity<br>2 h        | Capacity<br>4 h        | Capacity<br>6 h        |
|---------|------------------------|------------------------|------------------------|
| 3       | 9920 lb/h<br>4500 kg/h | 4960 lb/h<br>2250 kg/h | 3306 lb/h<br>1500 kg/h |

size



## XTRACT 4400

| Modules | Capacity<br>2 h        | Capacity<br>4 h        | Capacity<br>6 h        |
|---------|------------------------|------------------------|------------------------|
| 2       | 6613 lb/h<br>3000 kg/h | 3307 lb/h<br>1500 kg/h | 2204 lb/h<br>1000 kg/h |

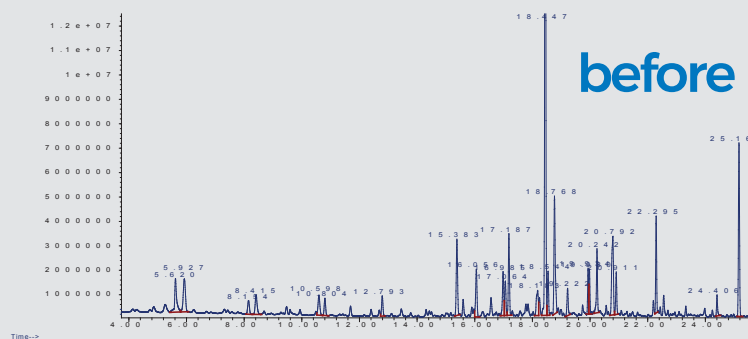
## XTRACT 10000

| Modules | Capacity<br>2 h         | Capacity<br>4 h        | Capacity<br>6 h        |
|---------|-------------------------|------------------------|------------------------|
| 4       | 13227 lb/h<br>6000 kg/h | 6613 lb/h<br>3000 kg/h | 4409 lb/h<br>2000 kg/h |

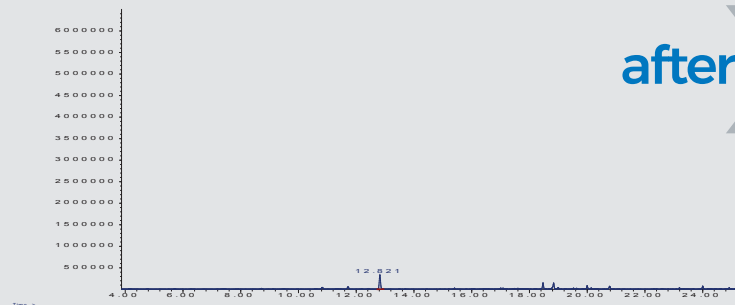
## ODOUR REMOVAL

Gas chromatography results before  
and after switching to VOCs Bandera

Abundance



Abundance



# PET PCR

## Rewriting quality standards

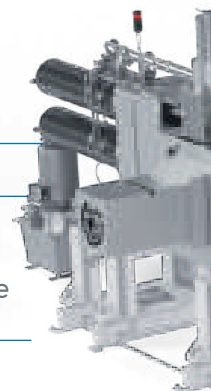
Bandera's long experience in the world of PET, with over 300 flake treatment plants worldwide, has allowed the development of a technology not only capable of delivering a quality granule, but also of redefining market standards. This offers plants with high capacities and with a minimum kWh/kg (kWh/lb) energy consumption for being able to prime maximise economies of scale to ensure a better return on investment.

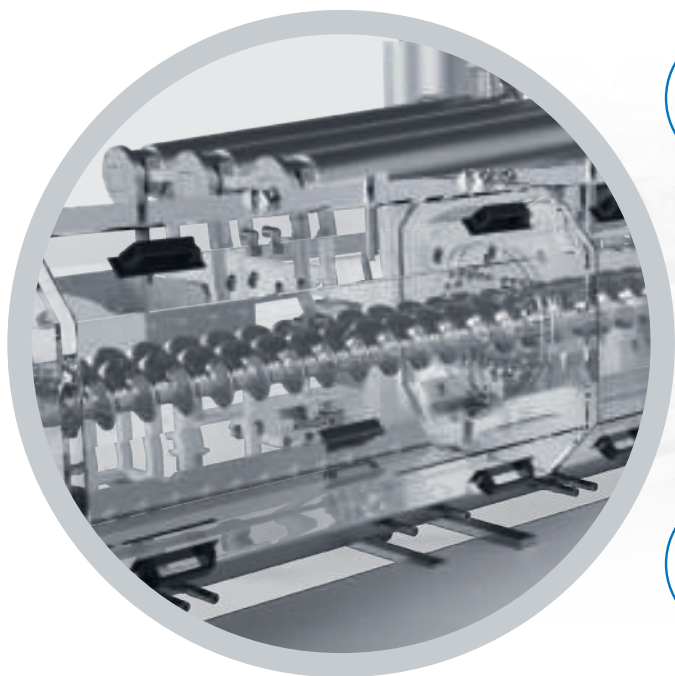
The patented **HVTSE<sup>®</sup>** technology, patent is based on the co-rotating twin-screw extrusion technology, with a length ratio of 52 diameters, designed to ensure a very high degassing efficiency while minimizing material degradation.



### Raw materials

| Product                     | PET bottle flakes PCR | PET Flat Film waste PIR | PET skeleton waste PIR | PET powder PCR | PET trays PCR | PET washing plant waste PCR |
|-----------------------------|-----------------------|-------------------------|------------------------|----------------|---------------|-----------------------------|
| <b>TWIN<sup>®</sup> PET</b> | X                     | X                       | X                      | X              | X             | X                           |





### MATERIALS

- PET bottle flakes PCR
- PET flat film waste PIR
- PET skeleton waste PIR
- PET powder PCR
- PET trays PCR
- PET washing plant waste PCR



### SIZES

- **TWIN\*\*** PET 1600: 

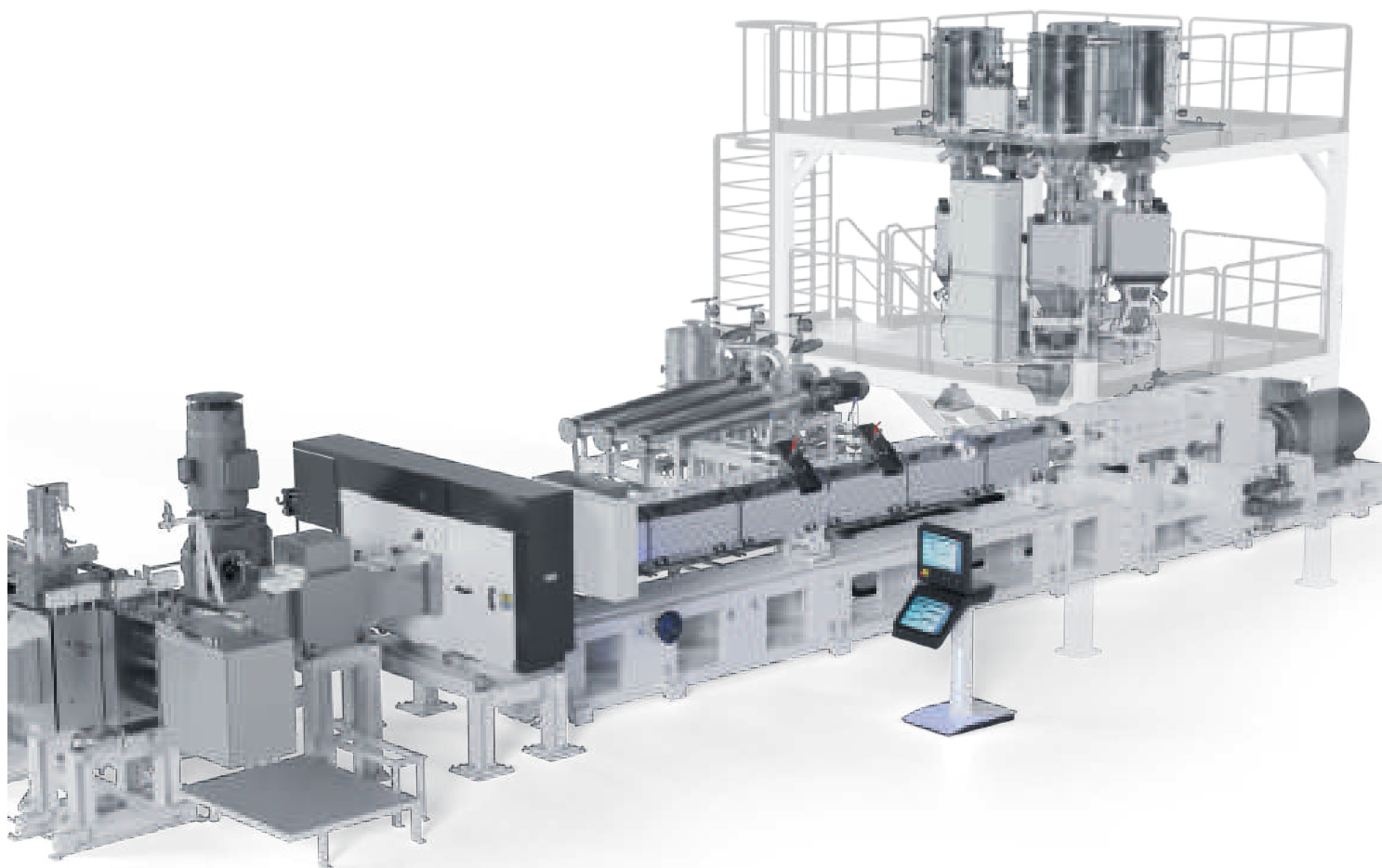
|                |                |
|----------------|----------------|
| 2425-3527 lb/h | 1100-1600 kg/h |
|----------------|----------------|
- **TWIN\*\*** PET 2300: 

|                |                |
|----------------|----------------|
| 3748-5070 lb/h | 1700-2300 kg/h |
|----------------|----------------|
- **TWIN\*\*** PET 3000: 

|                |                |
|----------------|----------------|
| 5291-6613 lb/h | 2400-3000 kg/h |
|----------------|----------------|
- **TWIN\*\*** PET 4000: 

|                |                |
|----------------|----------------|
| 6834-8818 lb/h | 3100-4000 kg/h |
|----------------|----------------|
- **TWIN\*\*** PET 5000: 

|                 |                |
|-----------------|----------------|
| 9039-11023 lb/h | 4100-5000 kg/h |
|-----------------|----------------|



04

# BOTTLE-TO-BOTTLE APPLICATION

## Easy, stable, circular

Thanks to the synergy between Bandera technology and Polymetrix, it is possible to reach the “bottle grade” through the process of solid state postpolycondensation.

Polymetrix is the market leader in the production of SSP.

The extruder **HVTSE®**, suitable to be coupled to any SSP system, achieves extraordinary results in combination with the SSP of Polymetrix, which is the only one that works with the principle of nitrogen instead of only vacuum.

**The results of the by-products with the Bandera-Polymetrix combination are particularly relevant since they are far below the market average.**

### SSPs benefit from using HVTSE® Bandera plant:

1. Decontamination in the extrusion phase
2. Minimum yellowing





05

## HOUSE OF EXTRUSION®

**Test** the material | **Prove** the result | **Lead** the market

The **House of Extrusion®** Bandera is the most innovative European centre for extrusion in the packaging & converting sector.

The 6000 m<sup>2</sup> (64584 ft<sup>2</sup>) area is dedicated to R&D activities and extrusion tests on complete production lines to create new solutions capable of anticipating market demands together with customers.

At our **EA Extrusion Academy\*\*** we co-develop advanced extrusion.

Here the best minds and researchers of Italian and European universities experiment new solutions thanks to constant investments made by Bandera to make available the most pioneering technology.

3D printer filaments, plastic photovoltaics, plastic electronics, smart packaging, flexible sensors, via nano composites like graphene are just a few examples of some recent studies.

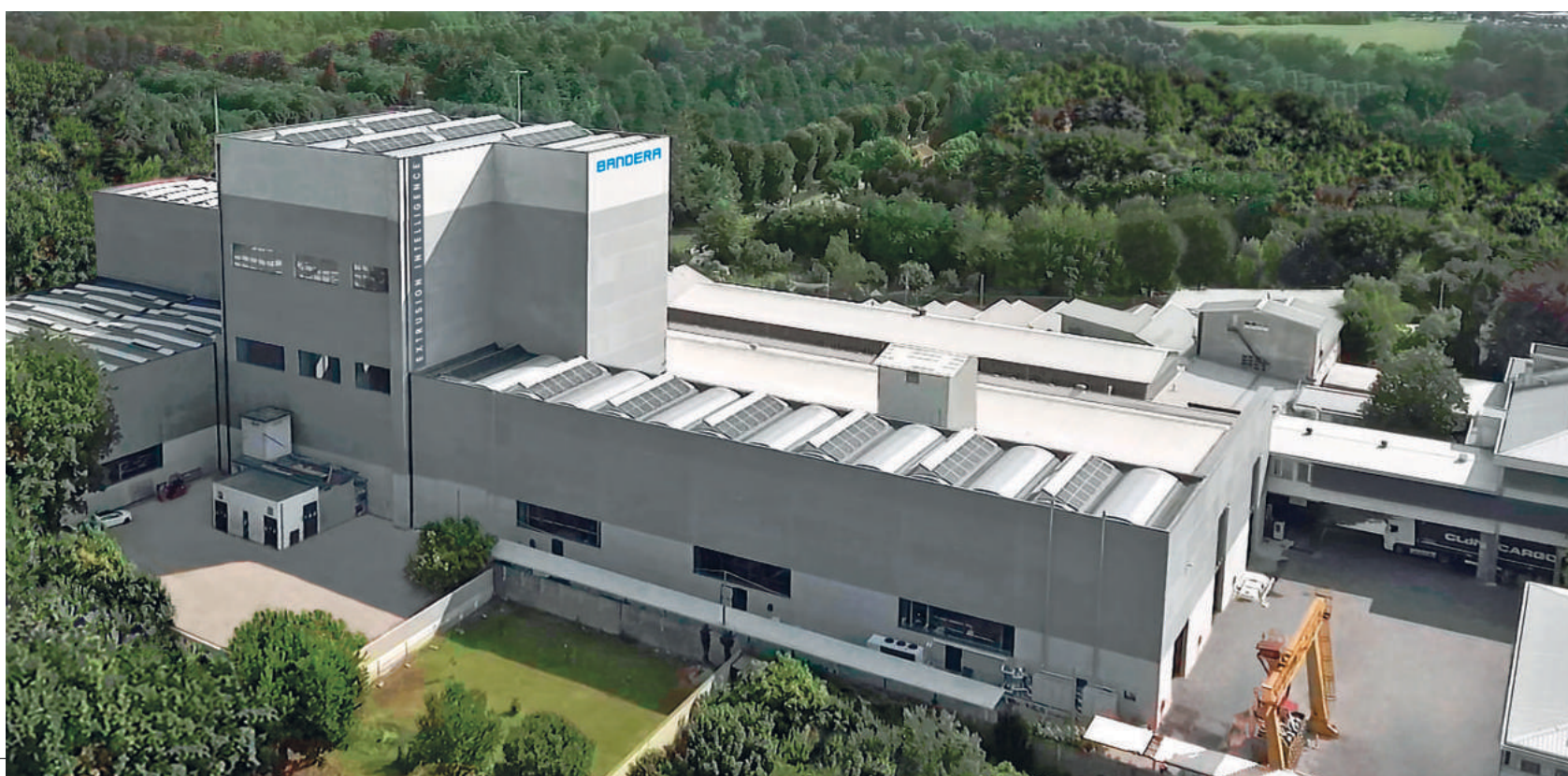
Each activity is protected by NDAs and can be carried out with Bandera or independently.





# SUSTAINABILITY IS ALREADY BENEFICIAL

**ECO**logically sustainable = **ECO**nomically advantageous



\* Trademark registered exclusively in EU countries

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beyond automation

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RECYCLING-ENG-V6-04-2024