www.erema.at

PET extrusion technologies

VACUREMA®

Prime

Advanced

Basic

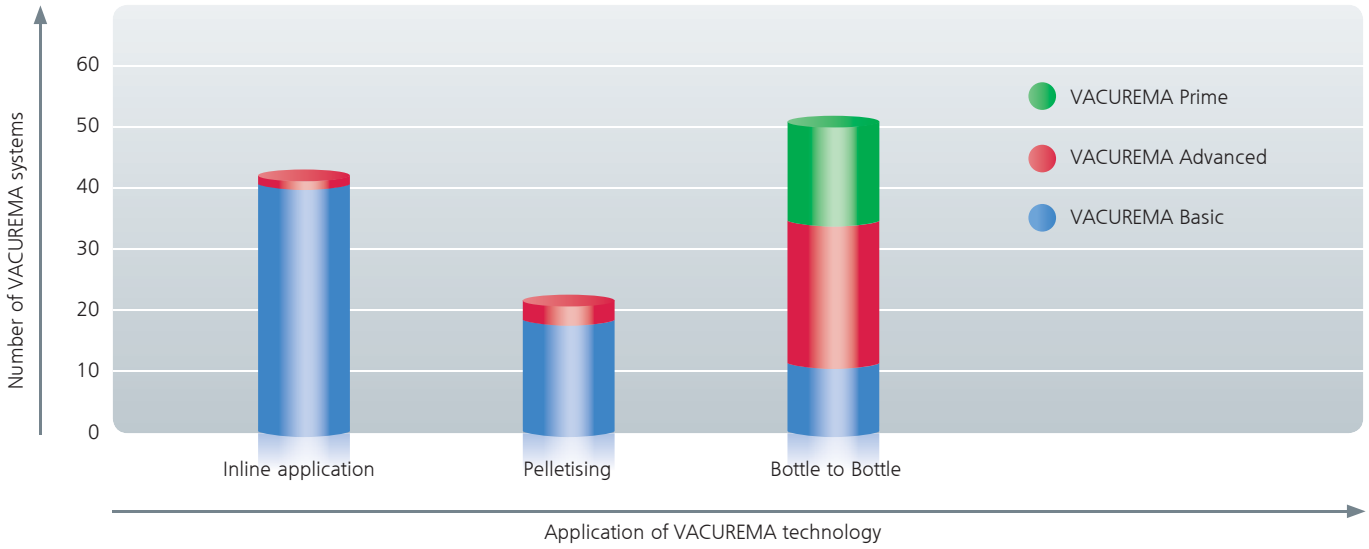
We know how.

EREMA®
HIGH TECH RECYCLING

VACUREMA® – one technology – 3 different applications

Different customer requirements call for different technological solutions. EREMA offers VACUREMA technology in three different systems – **VACUREMA Basic, Advanced and Prime** – according to the field of application and the requirements placed on the end product. Since it was launched the patented process has become the most widely used technology worldwide for recycling not only post consumer PET bottle flake but also PET in-house waste.

Fields of application of the VACUREMA technology



The basic principles of the VACUREMA technology

- **The patented pre-treatment at high temperature and in high vacuum before the extrusion process removes moisture and migration materials from the feedstock very effectively and in a stable process environment.** This prevents any hydrolytic decomposition of the melt in the extruder.
- IV stability despite fluctuations in moisture is achieved through the patented pre-treatment method. This means, therefore, that **input materials with higher material moisture levels can also be recycled.**
- Thanks to the patented pre-treatment of PET flakes with the VACUREMA technology the **IV increase and decontamination is fast, reliable and thus effective and energy-saving.**
- **FDA (among others) quality is ensured for the end products produced.**

Surface to volume ratio for flakes is 2.5 times higher than for pellets

BOTTLE FLAKE
Preground with a 12 mm screen,
average wall thickness approx. 0.1 to 0.4 mm

PELLETS
Typical dimensions:
approx. 2.5 mm diameter x 3 mm length or ball shape

Choose VACUREMA technology

1. Proven

The most proven and **most widely sold recycling technology for the processing of PET waste.** Over 120 systems are in use around the world, producing end products with an overall capacity of over 700,000 tons per year in a wide variety of application fields such as bottle-to-bottle, flat sheet, strapping, fibre, etc.

2. Extremely flexible

- Input material form variable: depending on the end application the system processes PET bottle flakes, ground amorphous skeleton waste/edge trim and virgin material (also in mixtures), i.e. bulk densities of 250 to 850 kg/m³.

- IV increase adjustable: depending on throughput and input material.

3. Highly efficient decontamination, ultra-low carbon footprint

The flakes are decontaminated quickly and efficiently. **Specific energy consumption per kg of material processes is very low. The carbon footprint is reduced even further by ecoSAVE®.**

4. Robust

The **sturdy and robust VACUREMA single-screw technology** with its extremely short extruder is insensitive to contamination solids and delivers sufficient melt pressure to meet the decisive quality criteria necessary for the fine filtration of solid matter.

5. Large area ultra-fine melt filtration

EREMA filter systems have very large active filter surfaces. This enables **filtration with up to 32 µm fineness** at low pressure. The result is highly clean repellets.

6. Pellets ideal for mixing with virgin material

Depending on the downstream equipment chosen the system produces **cylindrical or ball-shaped pellets** with the same geometry as virgin material. This means, therefore, that repellets produced with VACUREMA technology require no adjustment of dryers, crystallisers and preform machines.

7. Fully automatic

The innovative process control system software enables **extremely user-friendly and safe operation.** Additionally, users benefit from **start-up at the press of a button, fully automatic continuous operation, permanent monitoring for direct food contact (FCC) and the storage of relevant process parameters.**

ecoSAVE®

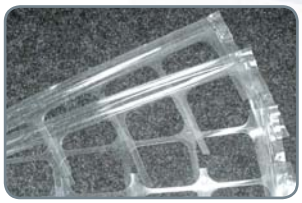
- **ecoSAVE® reduces energy consumption by up to 10%** as well as production costs and CO_2 emissions as a result
- High-quality energy-efficient components such as high-performance motors
- Ideal operational efficiency thanks to optimised control technology

VACUREMA® Basic

Every VACUREMA Basic system can be retrofitted if required to upgrade to a full VACUREMA Advanced system or VACUREMA Prime high-end system.

PET washed flake

PET skeleton waste



PET virgin material

PET flat film

Flexibility with input materials

From PET waste to the finished end product with minimum energy requirements

VACUREMA Basic has become firmly established in the field of so-called inline production systems. PET secondary raw materials such as bottle flakes, ground amorphous skeleton waste, virgin material, edge trim and mixtures of them with virgin material are recycled directly to make end products such as FDA approved and ILSI compliant thermoforming sheet and even fibres and strapping. Besides these inline products VACUREMA Basic is also used for the production of bottle-to-bottle compliant, ultra-fine filtered repellets. Minimum investment costs, lowest production costs and high product quality are convincing factors.

Technical benefits

- **High starting material moisture content up to 1.5% and fluctuating moisture permissible**
- **Processing of PET melt with stable IV values, minimum IV loss and lowest energy requirements for inline applications or pellet production**
- **Large-area ultra-fine filtration as standard**
- **FDA approved, ILSI compliant (efsa approval requested via customers)**

Economic benefits

- **Low production costs through specific energy consumption of 0.25-0.28 kWh/kg**
- NEW **ecoSAVE® reduces energy consumption by up to 10%** as well as production costs and CO_2 emissions as a result
- **Compact, space-saving design**
- **Robust single-screw extruder** technology, not as sensitive to solid contamination solid as twin screw extruders

IV change, input material to pellet: minor loss, approx. 0 to 4%
Specific energy consumption 0.25 to 0.28 kWh/kg

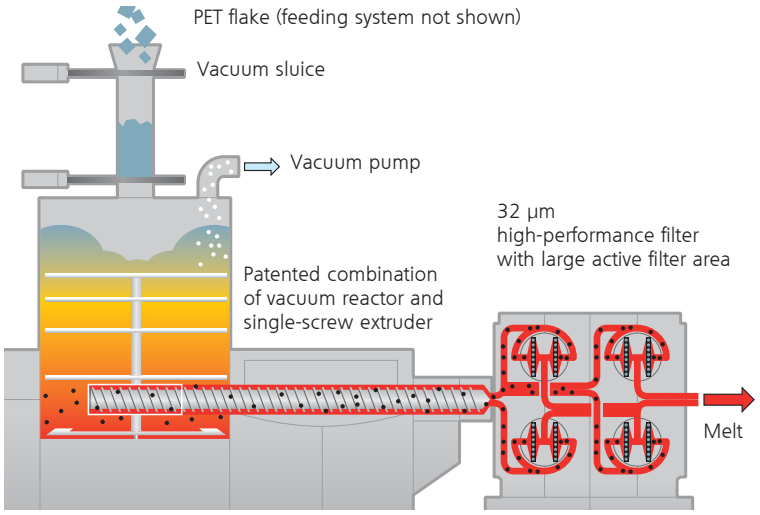
How it works

The system consists in its key components of a **vacuum reactor** which is linked directly to a single-screw extruder. The vacuum reactor unit is filled with amorphous, washed PET flakes via a vacuum sluice.

Decontamination and perfect predrying of the processed material take place inside the vacuum reactor. From the reactor the **material is fed in a high vacuum into the intake zone of the single-screw extruder.**

As a result no additional degassing ports are required on the extruder itself. This means that the VACUREMA technology dramatically **reduces the length of the extruder, reduces its energy consumption,** improves colour values (B value) of the processed material and keeps AA values to a very low level.

In the downstream high-performance fine filter the material is **filtered** with a **32 µm mesh screen width.** The filter system is equipped with a patented fully automatic self-cleaning system that enables long filter service life. **The now finished melt is then passed on to the downstream process for the production of end products such as fibres, strapping, thermoforming sheet or amorphous or crystalline pellets.**



System layout VACUREMA Basic

VACUREMA Basic food contact approvals/status

Approved for direct food contact by/in*:

US FDA (Category C-H & J)
Austria
Switzerland
Canada
Brazil
Argentina
Uruguay
Paraguay
etc.*

*Other countries to follow further to applications by the respective VACUREMA Basic users.

rPET produced with the VACUREMA Basic PET extrusion system complies with the following decontamination requirements/migration levels:

efsa approval requested via customers
European ILSI guidelines
German BGBI guidelines

Decontamination fulfils requirements for direct food contact

VACUREMA® Advanced

Can be upgraded at any time to VACUREMA Prime!

The globally proven bottle-to-bottle recycling technology

The patented VACUREMA Advanced extrusion system is the first expansion stage of the VACUREMA Basic technology. **Building on the VACUREMA Basic system,** it features an additional, continuously operating upstream vacuum crystallisation dryer. This makes an IV increase of around **4 to 6%** possible in the process from flake to repellets. As a result the system is interesting for the bottle-to-bottle application field.

Additional benefits compared to VACUREMA Basic

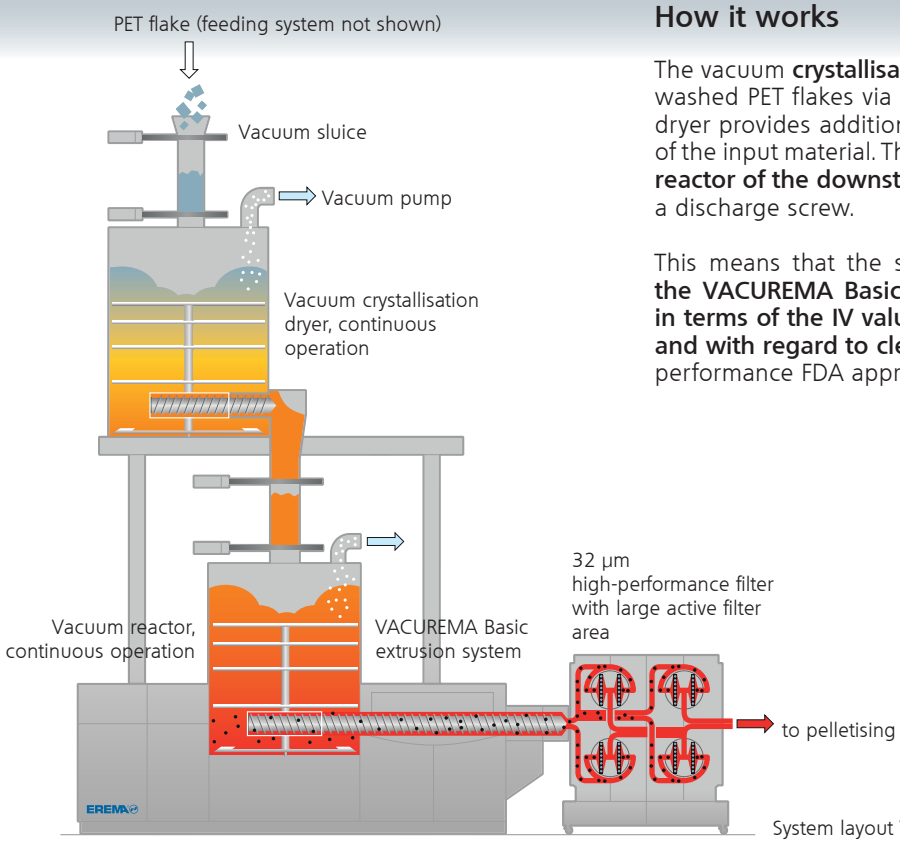
Technical benefits

- **Lowest thermal „heat history" through single energy input**
- Additional crystallisation dryer used - higher **build-up of IV values possible: 4 to 6%**
- **Stronger decontamination performance** through longer average dwell times
- NEW **AA (acetaldehyde) content in pellets less than 1 ppp** – possible in combination with optional pellet flusher

Economic benefits

- **Total production costs for rPET from Pet flake only approx. € 0.10 per kg** of finished BTB pellets
- **rPET pellets identical in consistency and appearance as virgin material,** choose between amorphous or crystalline with new CIC – Compact Inline Crystallisation
- **Compact, space-saving design**

IV increase, flake to pellet: adjustable, 4 to 6% increase
Specific energy consumption: 0.28 to 0.31 kWh/kg



System layout VACUREMA Advanced

How it works

The vacuum **crystallisation dryer** is filled with amorphous, washed PET flakes via a vacuum sluice. The crystallisation dryer provides additional predrying and decontamination of the input material. The material is then transferred to the **reactor of the downstream VACUREMA Basic system** via a discharge screw.

This means that the system has **all the advantages of the VACUREMA Basic technology and goes beyond it in terms of the IV values you can achieve in the pellets and with regard to cleaning efficiency.** Decontamination performance FDA approved, ILSI and afssa compliant.

VACUREMA Advanced food contact approvals/status

Approved for direct food contact by/in*:

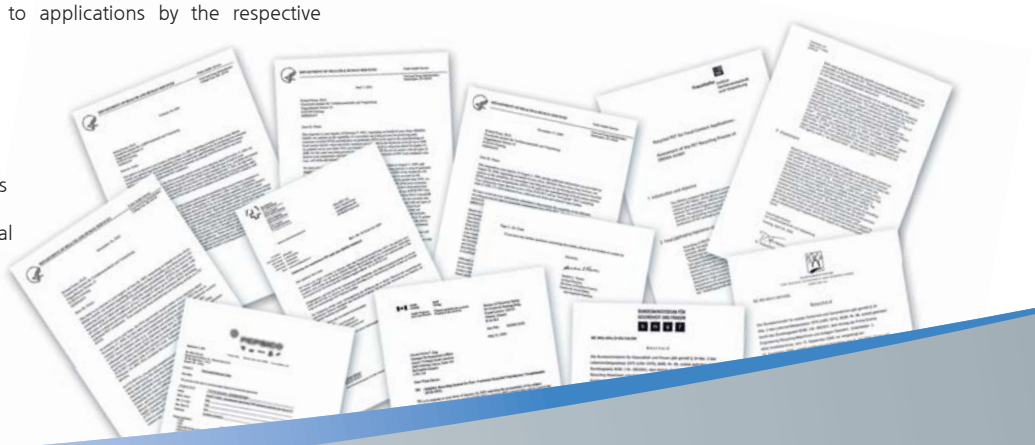
US FDA (Category C-H & J)
Austria
Switzerland
Canada
Brazil
Argentina
Uruguay
Paraguay
Brand owners
etc.*

rPET produced with the VACUREMA Advanced PET extrusion system complies with the following decontamination requirements/migration levels:

efsa approval requested via customers
European ILSI guidelines
German BGBI guidelines
French afssa guidelines

*Other countries to follow further to applications by the respective VACUREMA Advanced users.

The VACUREMA Advanced system has many individual country approvals. EREMA can help with country approval for all VACUREMA technologies.



VACUREMA® Prime

Superior cleaning effect, outstanding IV increase and ultra-low carbon footprint!

rPET pellets, ultra clean with IV on a par with virgin material

The rPET pellets produced with the patented VACUREMA Prime technology fulfil and exceed by far all minimum purity requirements for direct food contact PET packaging worldwide currently known to EREMA.

Building on the VACUREMA Basic technology this high-end extrusion system features **two crystallisation dryers operating in batch mode. This makes very large IV increases and extremely effective cleaning during the process possible.**

Additional benefits compared to VACUREMA Basic

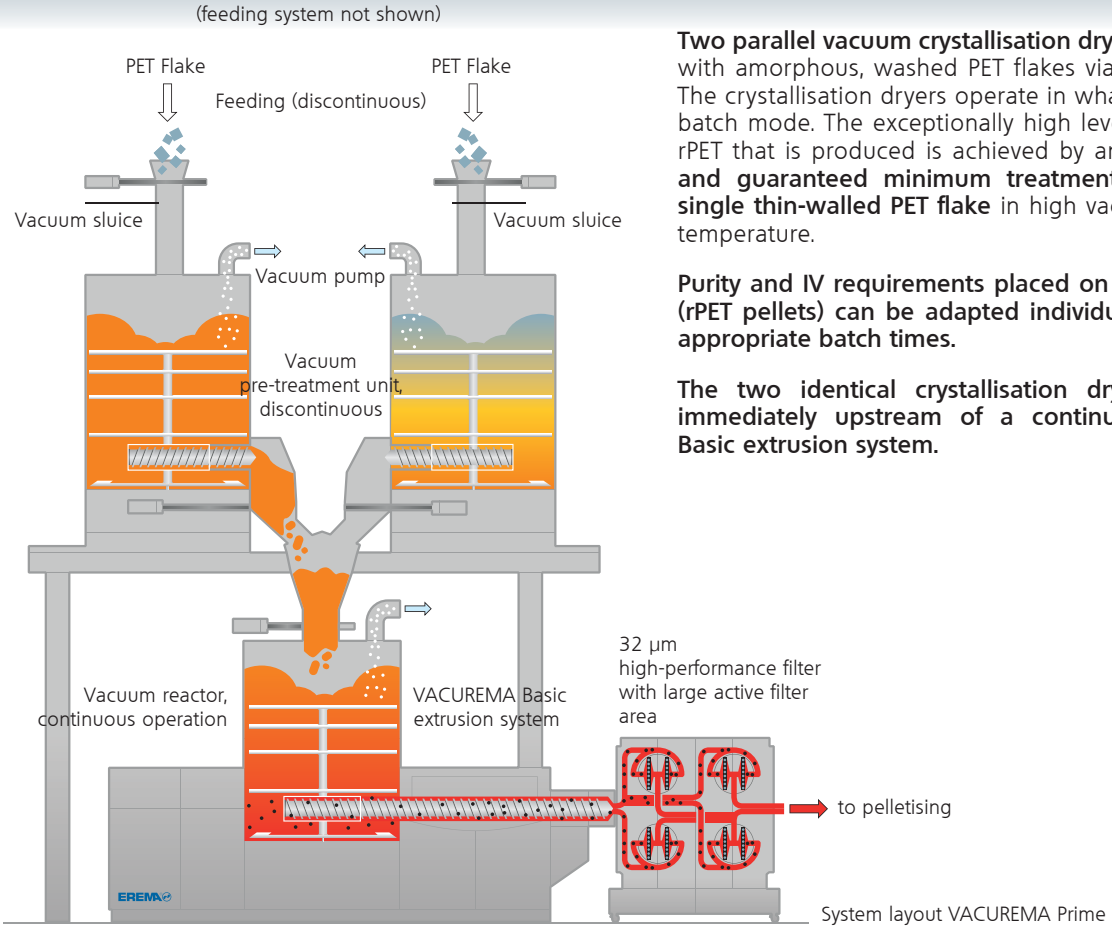
Technical benefits

- **Lowest thermal „heat history" through single energy input**
- **IV build-up: 6 to 10%** through the use of two additional crystallisation dryers
- **Batch operation – guaranteed, adjustable dwell times in the two crystallisation dryers** ensure maximum cleaning efficiency
- NEW **AA (acetaldehyde) content in pellets less than 1 ppp** – possible in combination with optional pellet flusher

Economic benefits

- **Total production costs for rPET from PET flake only approx. € 0.10 per kg** of finished BTB pellets
- **rPET pellets identical in consistency and appearance as virgin material,** choose between amorphous or crystalline with new CIC – Compact Inline Crystallisation
- **Compact, space-saving design**

IV increase, flake to pellet: adjustable, 6 to 10% increase
Very low specific energy consumption: 0.30 to 0.34 kWh/kg



System layout VACUREMA Prime

How it works

Two parallel vacuum crystallisation dryers are each filled with amorphous, washed PET flakes via a vacuum sluice. The crystallisation dryers operate in what is referred to as batch mode. The exceptionally high level of purity of the rPET that is produced is achieved by an **exactly defined and guaranteed minimum treatment time for every single thin-walled PET flake** in high vacuum and at high temperature.

Purity and IV requirements placed on the end product (rPET pellets) can be adapted individually by selecting appropriate batch times.

The two identical crystallisation dryers are placed immediately upstream of a continuous VACUREMA Basic extrusion system.

VACUREMA Prime food contact approvals/status

Approved for direct food contact by/in*:

US FDA (Category C-H & J)
Austria
Switzerland
Canada
Brazil
Argentina
Uruguay
Paraguay
Brand owners
etc.*

*Other countries to follow further to applications by the respective VACUREMA Prime users.

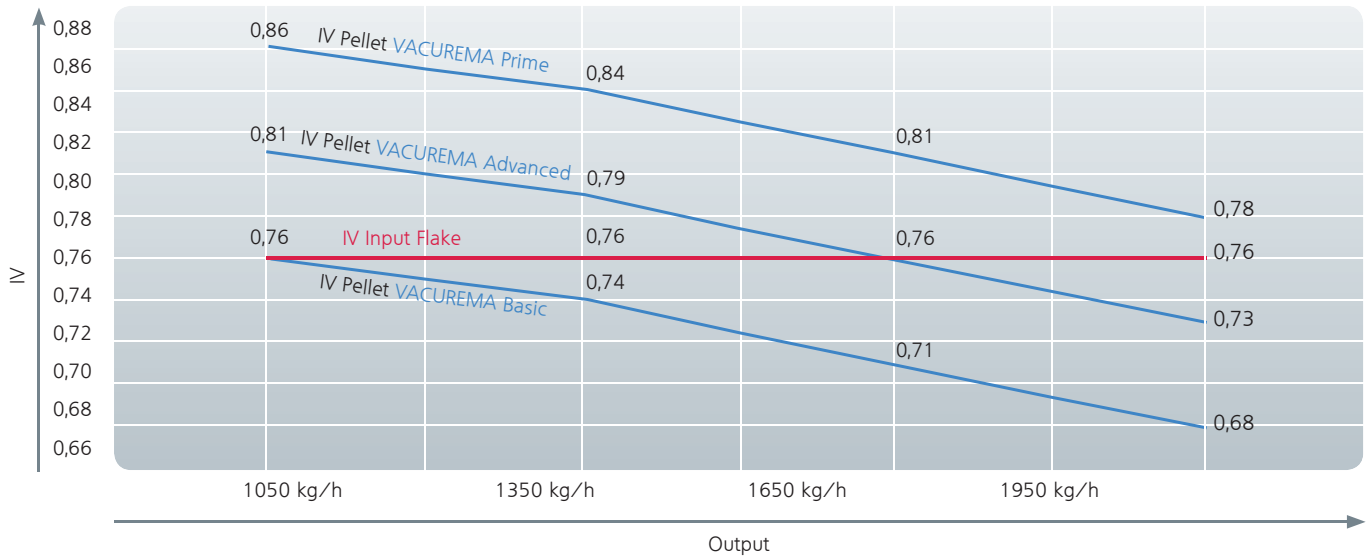
rPET produced with the VACUREMA Prime PET extrusion system complies with the following decontamination requirements/migration levels:

efsa approval requested via customers
European ILSI guidelines
German BGBI guidelines
French afssa guidelines
Brand owner guidelines

VACUREMA system features

IV values attainable in repellets – variable according to chosen throughput

Diagram: IV increase according to VACUREMA type and set plant throughput performance; example based on VACUREMA model 2018 T.



In practice and depending on the input material, pellets with different IV increase can be produced, especially with VACUREMA Advanced and Prime, by individually adjusting the throughput and process parameters of the system.

IV values in real time – extremely convenient

The continuous **online measurement,** combined with the fully automatic plant control system, means you can influence processing parameters such as vacuum, throughput and processing temperatures.

FCC – Food Contact Control – automatic operation mode

The parameters for direct food contact compliance are monitored continuously in the recycling process on all VACUREMA systems. The Food Contact Control (FCC) feature supervises the predefined process parameters according to legal requirements for the current production of recycled material.

If levels go beyond defined limits an alarm is triggered automatically and material flow is diverted away from the production line, thus ensuring traceability.

Integrated online IV measurement

Food Contact Control (FCC)

Find out more from your EREMA specialist!

VACUREMA® inline systems

What are known as VACUREMA inline applications have also become successfully established. These **systems are used to make finished end products directly from PET bottle flake as the starting material.** The unique advantage of all VACUREMA inline systems is their increase of value added through the direct production of end products without the detour of pelletising.

VACUREMA inline sheet systems

Direct production of PET flat film from 100% bottle flake or mixtures with virgin pellets, ground skeleton waste and edge trim. The sheet produced complies with the FDA purity requirements and is thus suitable for direct food contact (see separate folder).

VACUREMA inline strapping systems

Direct production of extremely tough strapping from 100% bottle flake (see separate folder).

VACUREMA inline fibre systems

Direct production of PET fibres from 100% bottle flake or mixtures with virgin pellets.

Technical data VACUREMA® PET extrusion systems

Systems available	Max. output	Basic		Advanced		Prime	
		IV output	IV change	IV output	IV increase	IV output	IV increase
VACUREMA 906 T	200 kg/h	150 kg/h		150 kg/h			
VACUREMA 1007 T	300 kg/h	190 kg/h		190 kg/h			
VACUREMA 1108 T	400 kg/h	250 kg/h		250 kg/h			
VACUREMA 1109 T	500 kg/h	300 kg/h		300 kg/h			
VACUREMA 1310 T	600 kg/h	400 kg/h		400 kg/h		500 kg/h	
VACUREMA 1512 T	900 kg/h	600 kg/h	0 bis -4%	600 kg/h	+4%	700 kg/h	+8%
VACUREMA 1714 T	1000 kg/h	850 kg/h		850 kg/h		1000 kg/h	
VACUREMA 1716 T	1500 kg/h	1100 kg/h		1100 kg/h		1350 kg/h	
VACUREMA 2018 T	2000 kg/h	1350 kg/h		1350 kg/h		1650 kg/h	
VACUREMA 2021 T	2600 kg/h	1800 kg/h		1800 kg/h		2000 kg/h	
VACUREMA 2321 T	2900 kg/h	2000 kg/h		2000 kg/h		2300 kg/h	

Demonstrations and test runs with your plastic material in our customer test centre are welcome by appointment.

Choose EREMA

- Proven and reliable technology from the global market leader
- Constant innovations secure the lead
- First class worldwide customer service guarantees lasting reliability and fast support
- Outstanding end product quality
- Customised individual solutions

EREMA®
HIGH TECH RECYCLING

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