EN Applications & Solutions

Working for a better **future**

Plastic Recycling Technologies

> Post Industrial Recycling
> PET Improvement
> Post Consumer Recycling

NGR®
PLASTIC RECYCLING TECHNOLOGIES

All
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NGR

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to change it
r the better.
– Josef Hochreiter – CEO –

l. to r.: Thomas Pichler,
Josef Hochreiter, Gerold Barth

SUCCESS NEEDS **A VISION**

The cost-effectiveness of industrial investments depends heavily on optimizing performance data. In times of radical change around the globe, we have to think about the issue of economic success on a much larger scale.

Since as early as the 1940s, plastic has taken over all spheres of our lives to an unparalleled degree. Although it is indisputable that the application possibilities of plastic are endless, global environmental problems and medical research results have come to light recently that are swiftly shifting our perception of plastic from a „miracle" substance to a rather problematic one. Sustainable handling of plastics, which have long become indispensable in our lives, has therefore been transformed from a mere marketing point into one of the most important drivers of business success, specifically in the technology sector.

What we were anticipating as early as 25 years ago is now our reality at NGR. From executives to specialist workers, we are all working together to reach a common goal: using our sophisticated technologies to make our future a little better. It is an excellent mission and a tremendous incentive that motivates us each day to tackle new challenges in order to work out the smartest solutions for providing you with energy-efficient and reliable plastics recycling.

PET Improvement (PET)

P:REACT is the next dimension of PET recycling. It only takes a few minutes to take PET from industrial waste or post-consumer PET and turn it into food-safe rPET. This groundbreaking innovation, which makes rPET material safe for food packaging (FDA, EFSA), is also of high interest to fiber manufacturers. This is because the Liquid State Polycondensation (LSP) method developed specifically for P:REACT ensures removal of the spinning oils without residual products during plastic processing. The advanced P:REACT technology is providing us with definitive proof that plastic recycling goes hand-in-hand with a brighter future.

Post Industrial Recycling (PIR)

Residual products left behind by the industrial production of plastic products are a high-quality and valuable raw material. To ensure that they can be fed back into production, we build recycling machines with maximum technological sophistication to handle this task flawlessly. When building these machines, we focus primarily on economic and environmental sustainability. NGR solutions preserve the full value of the material between input and output (zero-waste production) in addition to minimizing labor and energy expenditure. The benefits speak for themselves.

Post Consumer Recycling (PCR)

Nearly half of the plastic produced in the world gets thrown away after just one use. This waste could serve as a valuable resource if only we took advantage of it. Our one-of-a-kind recycling technologies are making crucial contributions to the solution. Through efficient material handling during the conversion process, minimized energy consumption and custom machine configurations, NGR makes sure that "one-way" plastics find their way back into the material cycle—giving the environment sustainable protection.

Post Industrial Recycling

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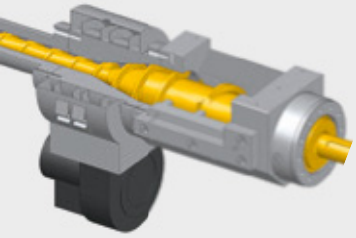
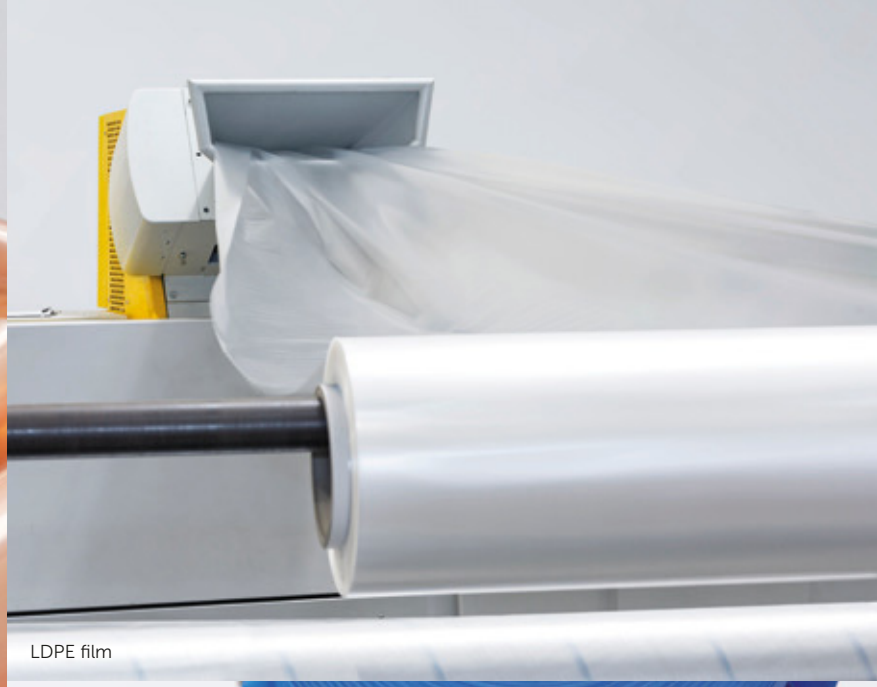
Post Industrial Recycling

E:GRAN

CHOPPER-FEEDER-EXTRUDER COMBINATION



PA6
film



LDPE film

PP
edge trim

The compact repelletizing solution **for any type of film**

A space-saving design, an energy-efficient drive and simple, intuitive operation. These are all features of **E:GRAN**, the re-processing technology for thermoplastic film edge trims and roll scraps.

Whether it's being used as a stand-alone solution or integrated with a film production process, E:GRAN stands out for its ideal in-feed thanks to the innovative chopper/feeder design. The chopped film material is pre-compressed and fed directly to the extruder. This makes it possible to carry out highly economical and environmentally friendly zero-waste production (all production waste is fed back in). Innovative control concepts allow the E:GRAN to adapt to fluctuating edge trim amounts automatically – for maximum product quality.

What else makes E:GRAN great? Its process stability, its energy efficiency and its compact size make it stand out across the board. Its robustness allows it to operate 24/7/365 while ensuring precise and consistent output.

AT A GLANCE

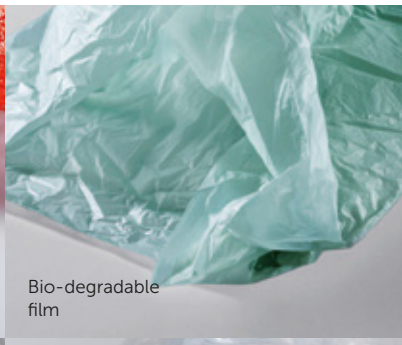
- **Effective film preparation**
- **Output rate up to 120 kg/h (270 lbs/h) depending on type**
- **Automatic adjustment of the extruder speed to fluctuating edge trim amounts**
- **Switching on and off by a single push button**
- **Clean, dust-free operation: The machine can even be installed in production halls**
- **One-step technology – without additional intermediate steps**

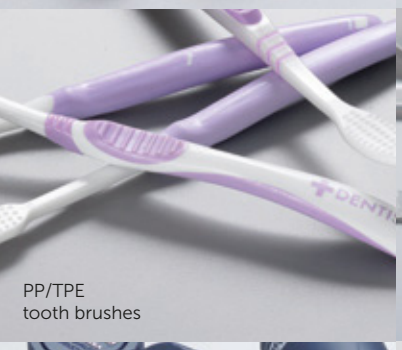
Post Industrial Recycling

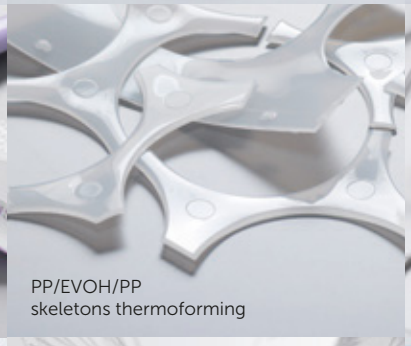
PE compound
bottle closures

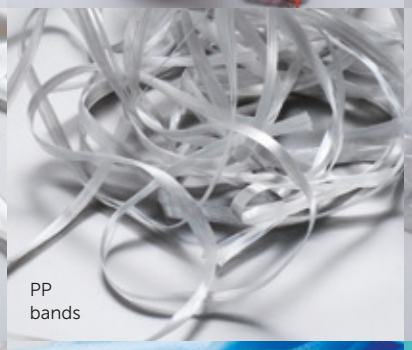
PMMA
injection molding sprues

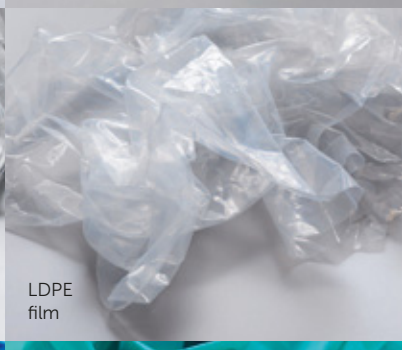
HDPE
nets


Bio-degradable
film

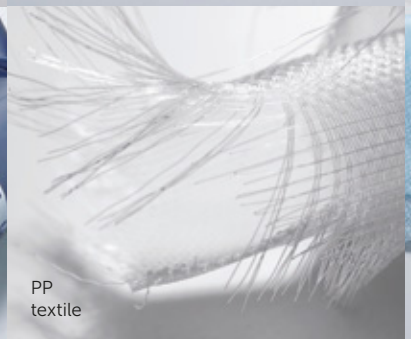

PP/TPE
tooth brushes


PP/EVOH/PP
skeletons thermoforming

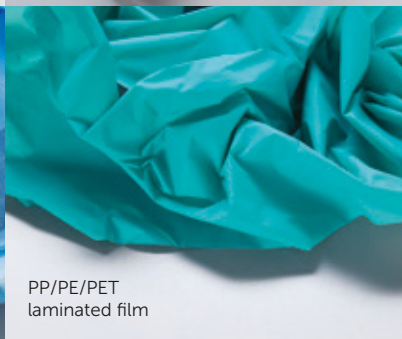

PP
bands


LDPE
film

ABS
bottle caps

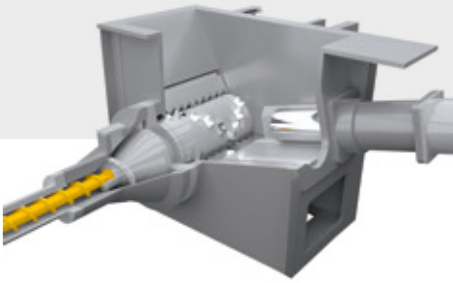

PP
textile

PP
nonwovens


PP/PE/PET
laminated film

A:GRAN

SHREDDER-FEEDER-EXTRUDER COMBINATION



The multi-talented, **high performer**

A:GRAN is the compact technology for scrap plastic products created in industrial processes of any type. The solution focuses on high performance in a compact space.

Thanks to the system's minimal energy consumption and material-conserving shredder, A:GRAN can be used to achieve zero-waste production (all production waste fed back in). This means that high efficiency and implemented sustainability are the biggest strengths of this recycling solution.

Thanks to the high capacity of A:GRAN, start-up lumps are actually re-processed without any additional pre-grinding. Do you have production waste that is created intermittently? No problem! This versatile solution switches on and off quickly and easily, enabling you to work efficiently and meet the needs of the shop floor.

AT A GLANCE

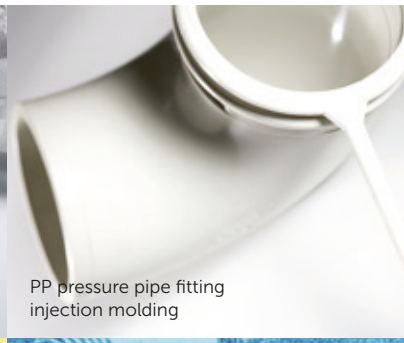
- **Processing industrial plastic waste of any kind**
- **Output rate up to 120 kg/h (270 lbs/h) depending on type**
- **Switching on and off by a single push button**
- **Quick and easy start-up and shut-down at any time**

Post
Industrial
Recycling

LDPE film
heavy printed

HDPE packging net
post industrial scrap

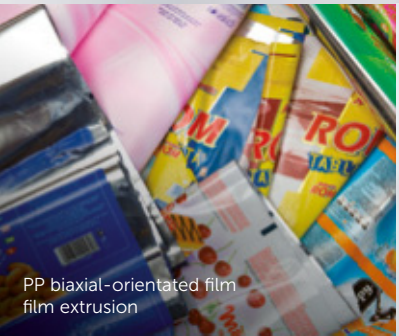
PP nonwovens
post industrial scrap

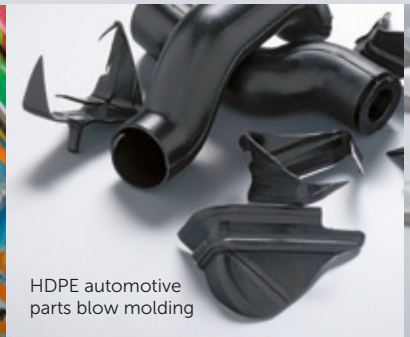

PP pressure pipe fitting
injection molding

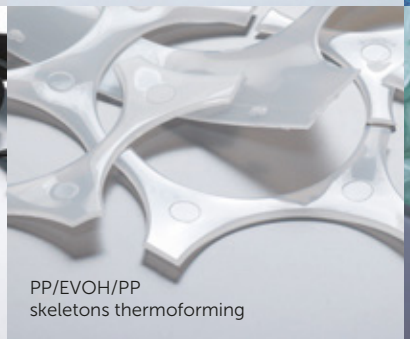
PEEK pipes
pipe extrusion

PP sheets
cut offs, scrap

PP carpets
post industrial scrap


PP biaxial-orientated film
film extrusion

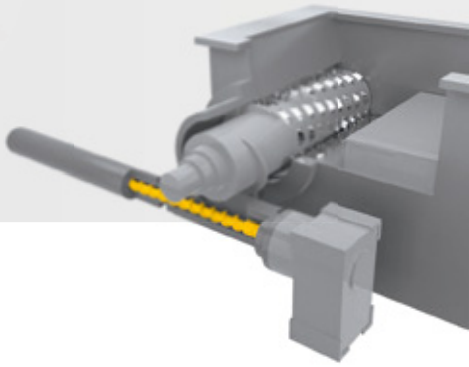

HDPE automotive
parts blow molding


PP/EVOH/PP
skeletons thermoforming

Bioplastics
post industrial scrap

S:GRAN

SHREDDER-FEEDER-EXTRUDER COMBINATION



The universal solution **for industrial plastic waste**

S:GRAN is the perfect solution for processing scrap plastic materials of a variety of types, materials and shapes created by industrial processes. Even thick-walled scrap plastic materials as well as fibers and textiles can be processed without additional pre-shredding.

S:GRAN meets even the highest standards for efficiency and achieves zero-waste production (all production waste is fed back in) thanks to shredding that conserves an outstanding amount of material as well as optimally guided extrusion.

The newest generation of this high-efficiency recycling technology provides a significant increase in energy efficiency and additional improvements to output rate for sustainable plastic waste processing.

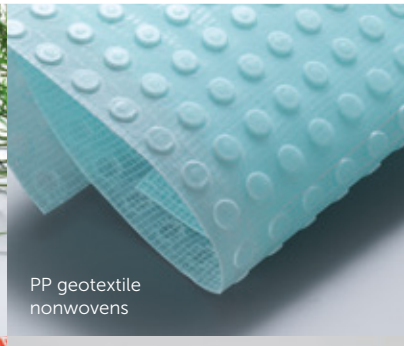
AT A GLANCE

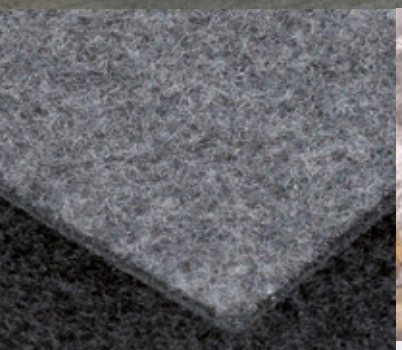
- **Simple, material-conserving processing of industrial plastic waste of any type**
- **Patented single-shaft shredder/extruder combination from the inventor**
- **Output rate up to 900 kg/h (1,980 lbs/h) depending on type**
- **Switching on and off by a single push button**
- **Quick and easy start-up and shut-down at any time**
- **Small footprint saves space**

Post Industrial Recycling

LDPE film roles
decored

PE artificial grass
post industrial scrap


PP geotextile
nonwovens


PP carpets
as role input

EPS blocks
foam extrusion

PP woven sack
post industrial scrap

PET lumps
extrusion start-up

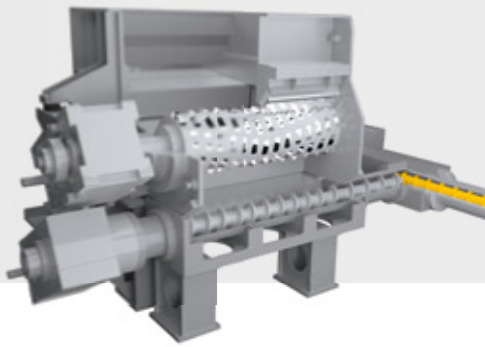
PP/PA ropes
single rope or as a role

PP yarns
agricultural application

PA carpet roles
post industial scrap

X:GRAN

SHREDDER-FEEDER-EXTRUDER COMBINATION



The power package for plastic waste **of all shapes and sizes**

Robust and extremely capable – the power of the **X:GRAN** is clear to see. The X:GRAN solution does more than just process all types of plastics waste. It even handles bulky materials such as large bales and carpet pads – without any additional preliminary size reduction.

X:GRAN is also at the cutting edge of efficiency. Thanks to its material-conserving shredders and optimally guided extrusion, you can be sure that the X:GRAN will achieve sustainable zero-waste production (all production waste fed back in).

X:GRAN is setting new standards in the high-output segment while at the same time working at maximum efficiency and with improved production capability.

AT A GLANCE

- **Easy, material-conserving processing, even for difficult industrial plastic waste**
- **Output rate up to 2,700 kg/h (5,940 lbs/h) depending on type**
- **Switching on and off by a single button**
- **Quick and easy start-up and shut-down at any time**
- **Small footprint saves space**

Post Industrial Recycling

PLASTICS RECYCLING **REIMAGINED**

CUSTOMIZED PERIPHERALS

As varied as the properties of the starting materials are, the requirements of our customers are consequently no less varied regarding production sequences, process and quality of the output downstream of the recycling procedure. Because of this, our philosophy at NGR is to understand your needs across the entire process chain and to develop a plastics recycling solution that matches them optimally. It is our goal that in the future, you will work with the technology that is ideal for you and your requirements and achieve a perfect result.

BEST PRACTICE
FILM MANUFACTURING SPAIN

Starting material
Film rolls with a length of 3,500 mm and a diameter of 600 mm

Requirements
> Easy material handling
> De-coring
> Recycling (zero waste production without loss of material)

THE CUSTOMIZED NGR PERIPHERALS SOLUTION
After a conveying lift has been loaded with film rolls, a conveyor belt picks up the rolls and transports them to the hydraulic splitter, where they are manually de-cored. Any unwanted residual particles are removed in the wind tunnel.

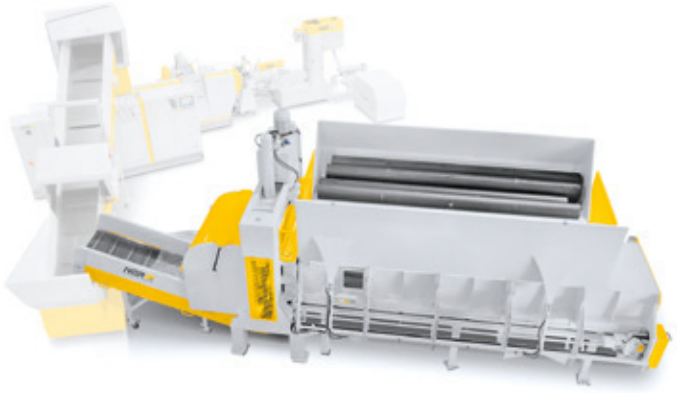
BEST PRACTICE
INJECTION-MOLDED BOXES GERMANY

Starting material
HDPE boxes in sizes up to 1,200 × 1,000 × 600 mm

Requirements
> Easy material handling
> Size reduction
> Recycling (zero waste production without loss of material)

THE CUSTOMIZED NGR PERIPHERALS SOLUTION
After a conveyor belt has been loaded with containers and boxes, the process circulation is started at the central control unit. The materials are conveyed fully automatically through the cutting area, where they are cut into pieces approximately 200 × 200 mm in size. The pieces then drop onto the conveyor belt of the downstream S:GRAN (shredder-feeder-extruder combination).

BEST PRACTICE
PIPE MANUFACTURING BELGIUM



Starting material
HDPE/LDPE pipes with a length of 4,000 mm and a diameter of up to 400 mm

Requirements
> Easy material handling
> Size reduction
> Recycling (zero waste production without loss of material)

THE CUSTOMIZED NGR PERIPHERALS SOLUTION
After a charging hopper has been loaded with PE pipes with a length of 4,000 mm, the process circuit is started at the central control unit. The pipes are conveyed forwards hydraulically and cut into rings between 500 and 600 mm in size using a guillotine. Then they drop onto the conveyor belt of the downstream S:GRAN (shredder-feeder-extruder combination).

BEST PRACTICE
FILM MANUFACTURING FRANCE

Starting material
BOPET film rolls with a length of 600 mm and a diameter of 400 mm

Requirements
> Automated material handling
> Low space requirement
> Recycling (zero waste production without loss of material)

THE CUSTOMIZED NGR PERIPHERALS SOLUTION
The machine is loaded fully automatically by an integrated lifting/tipping device for containers, thus eliminating the need for a conveyor belt and any manual labor.

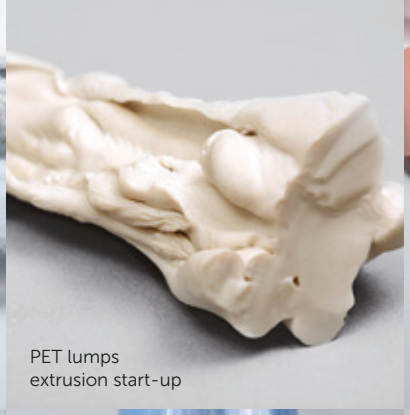
PET
Improvement

P:REACT

LSP: LIQUID STATE POLYCONDENSATION

PET fibre
fibre spinning

PET nonwovens
post industrial scrap


PET lumps
extrusion start-up

PET film
automotive airbag

PET bottle flakes
post washing line

PET preforms
injection molding

PET wovens
post industrial scrap

PET bottle flakes
mixed post washing line

PET trays
thermoforming

PET skeletons
thermoforming

The future of **PET recycling**

P:REACT makes it possible to revolutionize the PET recycling process. It transforms PET waste and PET bottle flakes into food-grade recycled PET in minutes.

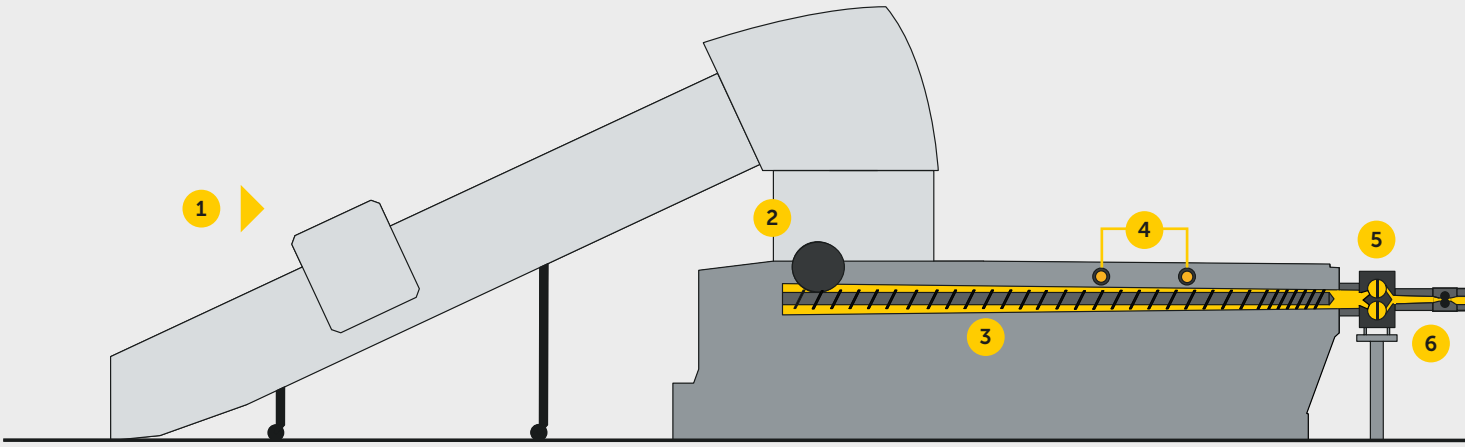
Thanks to the advanced LSP (Liquid State Polycondensation) process, the PET melt phase is used to trigger the polycondensation of PET. The reaction speed in the PET melt is significantly higher than in the solid phase. The clear advantage: IV values, controlled with pinpoint accuracy, that can be even higher than those of the original starting material – depending entirely on your objectives.

Additionally, we have paid attention to highest energy efficiency and minimization of operating costs when developing P:REACT – profitability is thus guaranteed. You will find all the details on this extraordinary PET recycling technology on the following 4 pages.

AT A GLANCE

- **PET recycling at the highest level**
- **Output rate up to 2,200 kg/h (4,840 lbs/h) depending on type**
- **Continuous process with enormous process stability**
- **Significantly higher energy efficiency than conventional SSP applications**
- **Approval by FDA and EFSA for 100 % food safety**

PET
Improvement



Benefit by benefit
by benefit

PURE FLEXIBILITY
Restrictions in material feed or composition? No limits with P:REACT. At the first process stage, post-consumer PET can be added either to film rests, reject rolls, edge trims, punch scrap (etc.) or to fabric such as fibers, textiles and fleece.

PURE FOOD SAFETY
The European Food Safety Authority (EFSA) and the U.S. Food and Drug Administration (FDA) both confirm that the Liquid State Polycondensation (LSP) process is fully food-safe.

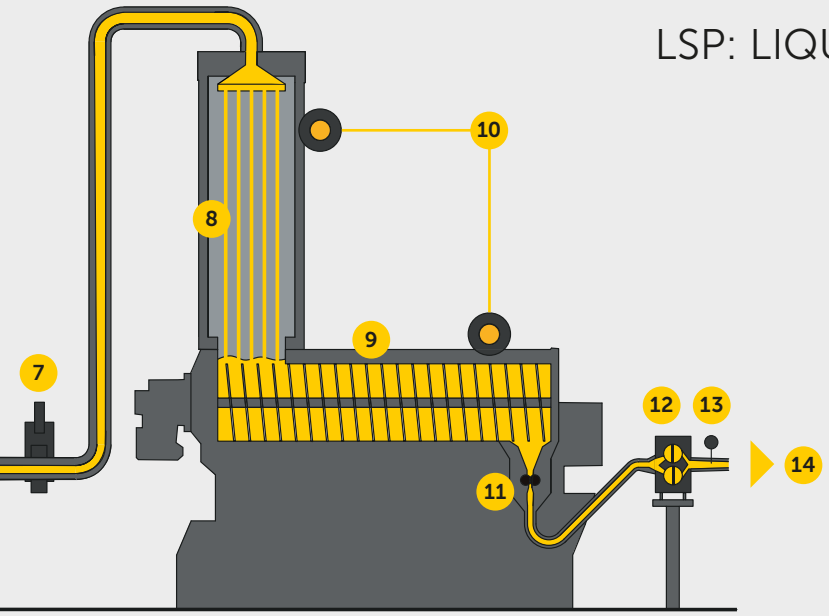
PURE PROCESS STABILITY
The vacuum container disconnects the mass flow from the upstream process stage. This disconnection, combined with the constant-throughput melt discharge pump, results in enormous process stability. In this way, the process quality in any subsequent production immediately downstream is significantly increased.

PURE DECONTAMINATION
Why is the decontamination of the material in the P:REACT so effective? It takes place right in the melt phase of the PET, until the PET leaves this process stage. The degree of purity of the finished rPET is significantly higher than the standards for food specified by EFSA and FDA.

PURE SAVINGS
If the P:REACT is operated with formulations from varying input materials, less of the expensive new PET material can be added or it can be omitted entirely.

P:REACT

LSP: LIQUID STATE POLYCONDENSATION



1) Manual and/or automatic material feed
2) Efficient size reduction
3) Plasticizing unit
4) Venting unit
5) Filtration
6) Melt pump
7) Bypass
8) Vacuum container (melt reactor)
9) Horizontal drum
10) Discharge of decontaminated substances
11) Melt discharge pump
12) Filtration
13) Viscosity measurement
14) Transfer to a downstream production system

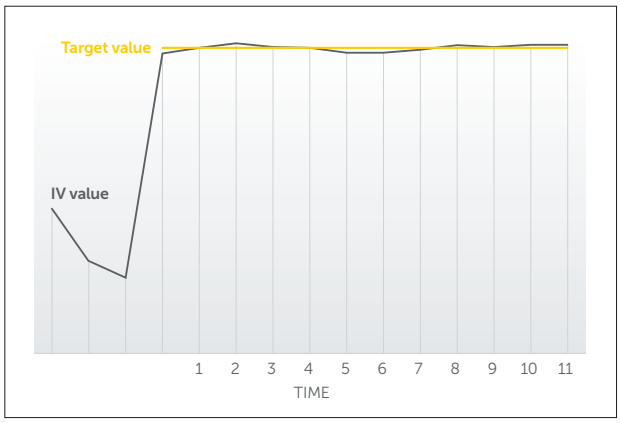
PURE SUSTAINABILITY

If no new PET material is added, the CO_2 balance improves enormously – with undiminished quality and retention of food safety.

PURE COST REDUCTION

Thanks to the P:REACT, new supply of thermal energy in separate production processes is no longer necessary. This entails high savings in energy and a much lower CO_2 footprint.

CONTROLLABLE IV-STRUCTURE



Due to the conditions prevalent in the melt reactor, ethylene glycol is removed. The equilibrium of the melt shifts in favor of higher degrees of polymerization. This process results in a chain-link generation of PET and subsequently in an increase of the intrinsic viscosity (IV) depending on the residence time of the melt in the vacuum container and the intensity of the vacuum. Thus, the IV value can be controlled actively using these two parameters. Deviations from the desired value are always kept within a minimum tolerance.

Typical IV curve: IV-decrease during plasticizing and subsequent increase up to the target value. The IV value is kept within a narrow tolerance band during decontamination.

A test reactor is operating in its own test center near our headquarters in Feldkirchen, Austria. There you can verify in person, using your own material, the outstanding properties of the P:REACT.

PET
Improvement

Exceeding the highest **expectations for production**

CONNECTING TO A FILM PRODUCTION SYSTEM

Significantly increased production volume and minimized process downtimes at the same time – the advantages of the P:REACT and its enormous process stability are plain to see. The more uniform material thickness of the films in downstream production, made possible by the process stability, reduces production costs – as does the option of modifying conventional formulations and of reducing the often fed virgin PET material or to cut it out completely. Thus, the use of the P:REACT becomes an important contribution to efficiency and practiced sustainability.

Starting materials

Some of them are: Loose film, reject rolls, edge trims, start-up lumps, punch scrap, reject parts, post-consumer PET (bottle flakes, trays, etc.)

A REAL BONUS

> **Changes of color are possible at any time in running operation – in contrast to other systems, shutting down and cleaning the machine to change color is a matter of the past with the P:REACT.**

CONNECTING TO A FIBER PRODUCTION SYSTEM

Fiber production is known for its stringent requirements for the recycling process. Here, P:REACT can take full advantage of its enormous process stability and push the output rate up to a previously unknown level. Minimized downtime increase the production volume significantly. Additionally, the effective decontamination during the melt phase results in reliable removal of chemical agents such as spinning oils. In short: P:REACT is the perfect partner for your reliable and stable fiber production.

Starting materials

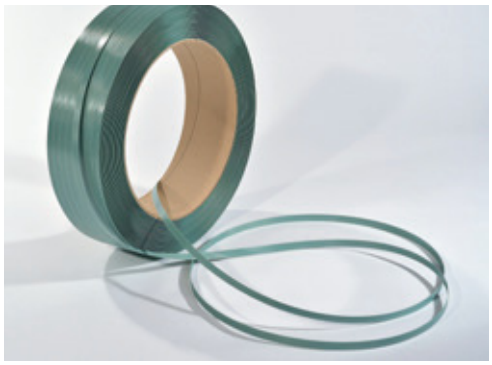
Some of them are: Fibers, fabric, fleece (nonwovens), textiles, post-consumer PET (bottle flakes, trays, etc.)

A REAL BONUS

> **The unique process stability of P:REACT reduces fiber breaks and thus enables significantly increased product quality.**
> **Reliable decontamination.**

P:REACT

LSP: LIQUID STATE POLYCONDENSATION



CONNECTING TO A PRODUCTION SYSTEM FOR STRAPS

A high and stable IV value is the basis for the production of high-quality straps. Here, the P:REACT demonstrates its strength in the exact control of the desired IV values. The improved quality, simultaneously combined with a reduction of the production costs (by reducing or omitting the addition of virgin PET material) renders the P:REACT the winner in the cost-benefit calculation.

Starting materials
Production waste, post-consumer PET (bottle flakes, trays, etc.)

A REAL BONUS

> **The IV increase up to the desired target value is the condition for a better product that can also sell at a higher price.**

PRODUCTION OF PET PELLETS

The effective decontamination and the precisely controllable IV buildup turn the P:REACT also into the ideal technology for the production of recycled pellets (rPET pellets), usually upstream of the flexible distribution on different production lines for further processing. There is one special feature that makes P:REACT score highly: consistent quality output despite feeding the most varied production and post-consumer waste.

Starting materials
Practically all common starting materials can be used, some of which are loose film, reject rolls, fabrics, production waste, post-consumer PET (bottle flakes, trays, etc.)

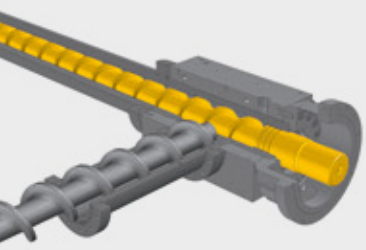
A REAL BONUS

> **The IV increase up to the desired target value is the condition for a better product that can also sell at a higher price.**
> **The decontamination right in the melt phase is highly effective and improves the degree of purity of the finished rPET enormously.**

Post Consumer Recycling

F:GRAN

FEEDER-EXTRUDER COMBINATION



PP regrind
fibers

HDPE flakes
post washing line

LDPE flakes
agricultural film

PP regrind
injection molding

LDPE flakes
post washing line

The efficiency star
for pre-shredded material

In recycling of ground up plastics, predominantly from plastic washing systems, there is no better choice than the **F:GRAN**. Flakes, even of varying size, are processed at a consistently high throughput rate.

F:GRAN is distinguished by its efficient material handling. The flakes to be processed are continuously circulated by rotors in a storage silo measuring up to 30 m^3. This prevents problems caused by bridging from the beginning.

Thanks to a wide range of various system sizes, F:GRAN can be implemented as a precise fit. Together with its significantly increased energy efficiency, this recycling technology is doubly cost-effective.

AT A GLANCE

- **Processing regrind and film flakes**
- **Output rate up to 2,300 kg/h (5,050 lbs/h) depending on type**
- **Switching on and off by a single push button**
- **Simple, stable process**
- **Storage silo up to 30 m^3 for material buffer**

Post Consumer Recycling

PET bottle flakes

PO mixed fraction
pressed post washing line

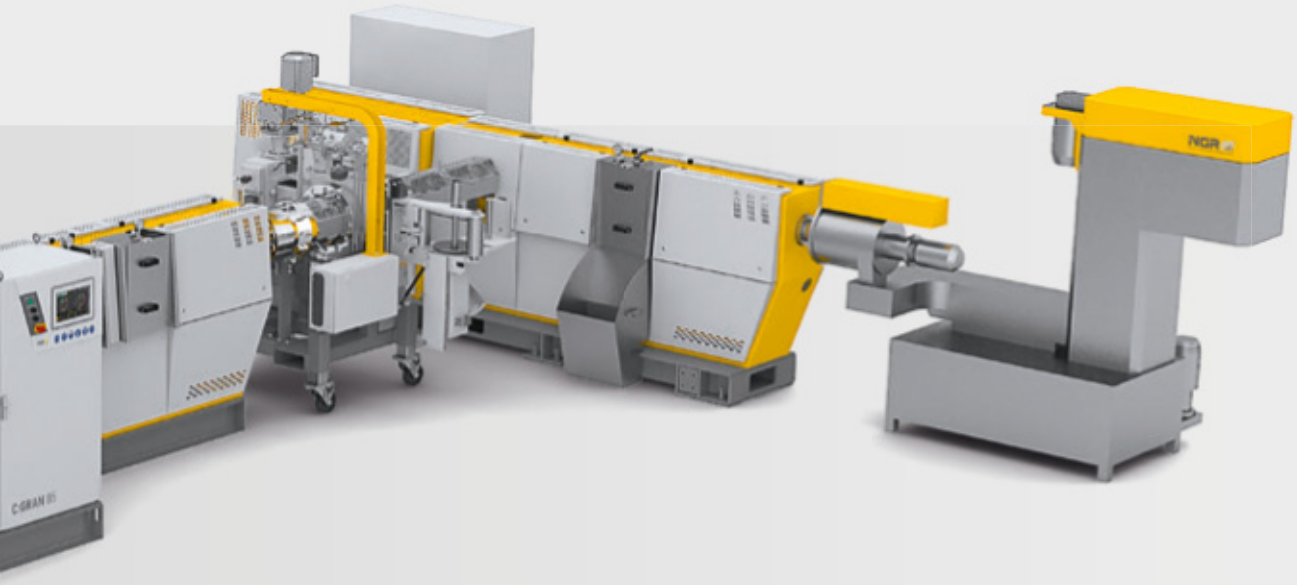
PE film flakes
post washing line

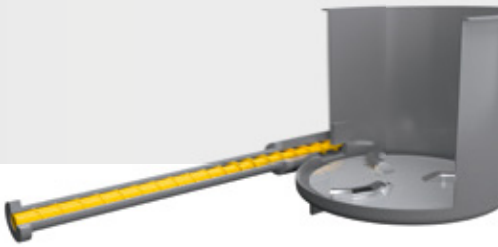
PP/PE mixed fraction
post washing line

Mixed
packaging films

C:GRAN

CUTTER-COMPACTOR-EXTRUDER COMBINATION





The cutting specialist **for wet materials**

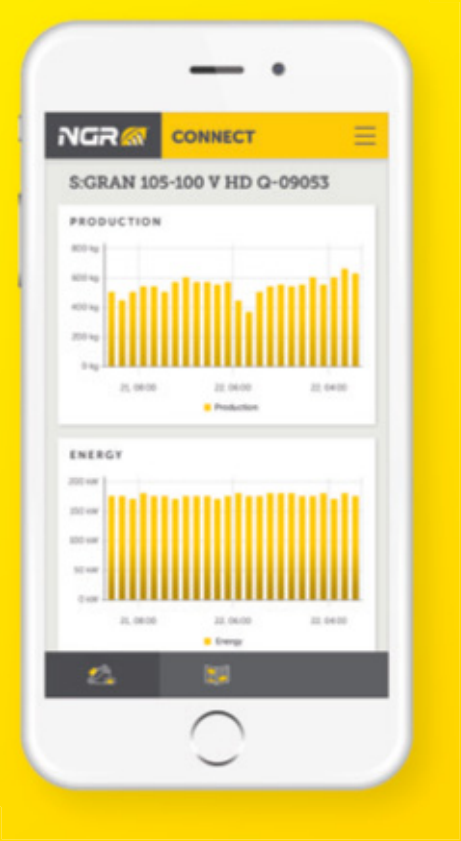
If the material has a high moisture content, **C:GRAN** is the ideal solution. Flakes or films with a residual moisture up to 25 % are processed in this recycling machine without problems thanks to its excellent pre-drying properties.

C:GRAN is distinguished by its advanced cutting geometry. For this, the fast-moving rotating blades in the cutter bin have been combined with efficiently arranged guides at the cutter bin outlet. In this way, the material is prepared for the extruder screw. C:GRAN is also an ideal option for a component of a cascade extruder or a compounding system.

ABMF is the automatic band-melt-filter perfectly matching C:GRAN. It has outstanding properties such as high degrees of filtering fineness, continuous extruder operation during the band filter transport, cyclic band filter replacement and fully automatic operation.

AT A GLANCE

- **Preparation of flakes and films with residual moisture up to 25 %**
- **Output rate up to 1,700 kg/h (3,700 lbs/h) depending on type**
- **Temperature regulation in the cutter bin**
- **Ideal as a component of a cascade or compounding system**
- **Makes a perfect combination with ABMF melt filter**



NGR CONNECT – **workflow redefined**

With NGR CONNECT, NGR breaks new ground in communication and documentation between manufacturer, user and machine. Remote maintenance has traditionally been used to respond to problems after they have occurred. This new software solution, on the other hand, enables continuous transmission of all operating parameters, making it possible to identify problems when they start or prevent them entirely. Thus, NGR CONNECT increases economy and output and simultaneously reduces unproductive downtime.

NGR CONNECT – for an even better partnership!

THE BENEFITS OF NGR CONNECT AT A GLANCE

WORKFLOW PRECISION
The NGR CONNECT software identifies problems as soon as they begin to emerge. Human and machine get closer together for maximally optimized operation of the system.

24/7 ONLINE
All authorized users, such as production managers, quality managers, persons in charge of maintenance and CEOs, can access the current and past operation parameters at any time – easily over a web interface using any browser.

CONNECT MOBILE
A specially developed app enables authorized users to access the operation parameters at any time, even from mobile terminal devices such as smartphones and tablets.

ACCESS AUTHORIZATIONS
It is possible to predefine exactly who will have access to which data. This ensures that each user will only view exactly those parameters that they need for their work and analyses. Thus, nobody will be flooded with data.

KPI DOCUMENTATION
NGR CONNECT collects all relevant key performance indicators (KPIs) that the users need for evaluating the machine performance.

FULL DATA SECURITY
For the communication, NGR uses a cloud service provided by a globally active cloud provider. Thus, data security and security standards against external access are maintained at the highest level.

MAINTENANCE? CHECK!
With NGR CONNECT, correctly observed maintenance intervals are no longer an issue. If a service case is coming up, the software issues corresponding notes. In addition, all maintenance work is documented automatically with the highest precision.

CHECKING PROCESS QUALITY
Thanks to the continuous supervision of all parameters, any deviation from the target process quality can be detected and corrected quickly. Beyond that, the stored production parameters allow for seamless documentation of product quality.

ONLINE REGISTRATION FOR SERVICE
Using the software, service tickets for maintenance work can be requested directly at NGR at any time. No need to call or e-mail for a service appointment – for more time in everyday work.

NGR customer service – **perfect satisfaction included**

Excellent technology requires excellent customer service. Ensuring the highest efficiency and minimized downtime of the recycling machines by providing excellent worldwide support is NGR's foremost goal. The offerings of the NGR Service Sextet are not only based on our 100 % commitment to perfect service but also on our highly trained employees and specialists who know the technology like the back of their hand.

SERVICE HUBS

For processing all maintenance and repair work as quickly as possible, perfectly trained employees are on duty at the NGR Service Hubs in Europe, North America and Asia. This network makes perfect user support and fast, professional solutions possible.

SPARE PARTS CENTERS

NGR's main spare parts warehouse is located in Feldkirchen, Austria. From here, spare parts are sent all over the world. In order to further shorten the response times in the strong American market, a well-stocked spare parts warehouse in North America serves the entire American continent.

SPARE PARTS AVAILABILITY

The time frame in which a machine can be repaired if necessary often depends on the availability of spare parts. NGR's strong service commitment is made possible by particularly high stock levels at the spare parts centers in Europe and North America.

WORLDWIDE EXTRUDER SCREW PRODUCTION SITES

The entire performance of the recycling machine depends on its extruder screw. Because of this, NGR cooperates with certified manufacturing partners worldwide for short-term manufacturing or repairs of this crucial element of technology.

WEBSHOP

The NGR online shop offers you a real benefit: After logging in, you will view only those spare parts that are relevant for your NGR machines. Thus, you can be sure you are ordering the right part for the right machine.

STARTER AND SPARE PARTS PACKAGES

For each new machine, the specialists from NGR bundle individual packages with spare parts. Thus, you have those parts that you might be likely to need soon at your production facility, always on site and ready for use.

NGR SERVICES –
perfect satisfaction included!

NGR test centers – **development laboratories for all requirements**

Plastics from everyday life, industry and science exist in a wide variety of shapes, haptics, compositions and colors. Because of this, any material to be fed to the plastic recycling process has its specific requirements for the complex processes within the high-performance machine so that it can be converted into high-quality material for further processing. The optimization of all configurable processing parameters plays an important part in this.

In our NGR test centers, NGR plastics recycling machines are ready for the purposes of presentation and process optimization. Here, specialized employees with profound knowledge of any technology in our product range offer process tests to our customers and prospective customers in order to define the optimal procedures for specified starting materials.

Do you want to improve your recycling formulations and optimize your machine parameters together with our professionals as our existing customer? Or do you want to get introduced to the technology as a prospective new customer or investor? The NGR test centers are the right place to go for plastics recycling at the highest level.

You provide us with your starting material, get a first-hand view of the application on site and expand your knowledge about your machine. In each NGR test center, there is an analysis area for these purposes, where all values relevant to your material can be determined under laboratory conditions.

NGR test centers – the basis for perfect performance data!

SUCCESS
NEEDS
A VISION

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