PET IMPROVEMENT SERIES
LSP - LIQUID STATE POLYCONDENSATION

P:REACT

> Continous operation by design
> Rapid IV-increase
> High decontamination performance
> Automatic control of IV-level
> FDA approved for 100% food contact
> High energy efficiency

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NGR RECYCLING MACHINES
MEMBER OF NEXT GENERATION GROUP

THE LIQUID STATE POLYCONDENSATION PROCESS

The LSP-Process utilizes the inherent capability of PET to condensate in the molten phase under vacuum. This condensation leads to an increase of IV. The high performance vacuum effectively decontaminates the material from harmful chemicals, - securing further use of the material for 100% food contact.

As molten PET enters the vertical part of P:REACT, strands are formed to create a suitable surface to volume ratio. The material is then collected in a horizontal drum and slowly pushed forward. Condensation starts immediately as the strands are formed and is set forth until PET exits P:REACT. IV increase is controlled by the residue time and the vacuum level of the molten PET inside P:REACT and therefore can be adjusted to a desired level. The settings of parameters allow the control unit to maintain the desired IV-level within a small tolerance-band.

The decontamination performance is extremely effective, as carried out in the liquid phase of PET. The cleaning of the material exceeds limits set by recognized food safety standards, but also effectively removes spin oil from fibers. The IV increase can be measured in approx. 0.01 dl/g per minute.

CONTINUOUS OPERATION BY DESIGN

The continuous operation of P:REACT provides rPellets within a narrow IV-range, suitable for usage in valuable high end applications (i.e. fiber-spinning or sheet extrusion). Batch related IV-fluctuations are simply designed out.

RAPID IV-INCREASE

The favorable conditions inside P:REACT (temperature/surface:volume ratio of the melt/high performance vacuum), easily initiates the condensation-process of PET. This results in IV increase rates of some 0.01 dl/g per minute. Faster reaction leads to faster results and a more profitable operation.

HIGH DECONTAMINATION PERFORMANCE

The separation of harmful contaminants, as spin-oils or those components not desired for food contact, are removed by high performance vacuum.
This high decontamination performance allows the use of P:REACT for many applications for highest flexibility.

AUTOMATIC CONTROL OF IV-LEVEL

P:REACT actively controls the residue-time of the PET-melt and the vacuum inside the reactor and automatically adjusts the machine parameters to receive the desired IV at a consistent level.

FDA APPROVED FOR 100% FOOD CONTACT

Scientific, third party tests show, that harmful components in the PET-melt are easily and securely removed within P:REACT, ensuring highest safety standards for 100% food-contact.

HIGH ENERGY EFFICIENCY

The recycling of PET requires the material to be melted. P:REACT uses the melt-energy for condensing PET. The reactor itself only maintains the heat-level. P:REACT is therefore highly energy-efficient, which results in low operating costs.

HIGH-GRADE RAW MATERIAL

rPellets with well distributed moll-mass and acceptable discoloring values

Extremely good decontamination performance

Consistent high quality due to continuous and controlled process

CUSTOMER SERVICE

Test runs with your PET-materials in our testing center

High availability of spare parts through regional warehouses

Expert advice in PET-recycling from selection of suitable equipment to financing

INCREASE PROFITS

Adjustable IV-lifts create higher values in the rPellets

Space-saving integration in your material logistic chain

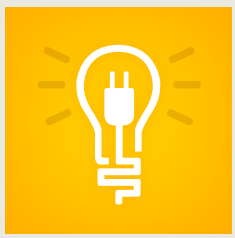
IV-increase within minutes

INNOVATIVE TECHNOLOGY

Adaptable equipment also for direct conversion of melt to finished products

Integrated control unit with melt preparation equipment

Extreme low requirements on floor space



POWER INTELLIGENCE

Fast set-up with low material-storage requirements

Full energy-management via central control unit

Extremely low energy consumption

EASY OPERATION

Inline IV-measurements secure the polycondensation-success

Very few mechanically operating parts – lower maintenance costs

Only two parameters control the LSP-process

MATERIALS


1


2


3


4


5


6


7


8

1. Bottle flakes
2. Fibers
3. Wovens, non-wovens
4. Sheets
5. Thermoform-skeletons
6. Preforms
7. Start-up lumps
8. Trays

LSP
LIQUID STATE POLYCONDENSATION

MELT PREPARATION

1


2


3


4


1. S:GRAN
SHREDDER-FEEDER-EXTRUDER COMBINATION

2. X:GRAN
SHREDDER-FEEDER-EXTRUDER COMBINATION

3. F:GRAN
FEEDER-EXTRUDER COMBINATION

4. C:GRAN
CUTTER-COMPACTOR-EXTRUDER COMBINATION

P:REACT can also improve PET-melts coming from other extrusion-sources

VACCUUM UNIT

For initiating the polycondensation of PET and to effectively remove non-desired chemicals, the P:REACT is permanently kept under high performance vacuum.

The gases received from the LSP-Process undergo treatment in the condensation unit. A cooler is installed in the re-circulation circuit to remove the heat of the condensation and the sensible heat of the process vapor. Removals, such as spin-oil, are effectively captured.

CONTINUOUS INLINE IV MEASUREMENTS

At the end of P:REACT, the IV-value is continuously and automatically measured. This measurement is the basis for adjusting the automatic system controls for achieving most consistent IV rates in the rPellet resp. finished product.

The IV measurements are stored in the central control unit and are used for traceability, thereby actively supporting quality-management.

CENTRAL CONTROL UNIT

All equipment functions of P:REACT and the recycling-equipment (melt preparation unit) are controlled via the central terminal.

Recipes are managed with this easy to read and write NGR touchscreen, thereby securing traceability as well as reproducibility.

PROCESSING EXAMPLE

INPUT MATERIAL
IV-Value (dl/g) **0.62**
(Pet Fiber)
moisture 3600 ppm

SHREDDER-FEEDER-EXTRUDER COMBINATION

P:REACT

PELLETIZING

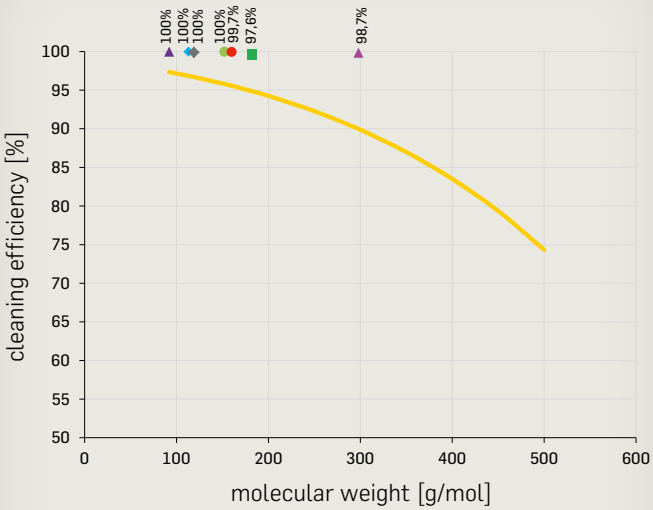
rPELLETS
IV-Value (dl/g) **0.70**

ENERGY EFFICIENCY

P:REACT works extremely energy-efficient, as the reactor only requires energy for maintaining the heat-level oft the molten PET.
Energy measurements at P:REACT show a specific consumption of only 0.12 kwh/kg including pelletizing.

Above figures reflect the processing of PET fibers at IV of 0.62 dl/g, an output of 350 kg/h on a Shredder-Feeder-Extruder Combination.
The rPellets are showing an IV of 0.70 dl/g.

APPROVALS



- Toluol
- Chlorbenzol
- Chloroform
- Methylsalicylat
- Phenylcyclohexan
- Benzophenon
- Methylstearat

Pet-Challenge Test carried out by Fraunhofer IVV Freising, Germany to determine the cleaning efficiency of P:REACT with the LSP-Process. Yellowish curve indicates the level of confidence provided by EFSA (European Food Safety Authority).

DECONTAMINATION PERFORMANCE

The Challenge test is carried out with purposely contaminated PET bottle flakes. (Seven above mentioned chemicals). These PET bottle flakes are then run through the P:REACT. The produced PET rPellets are again checked for remaining contamination.

The results show, that 4 out of 7 chemicals are not traceable due to the extreme good decontamination performance. The other 3 chemicals have been removed way over the confidence level of EFSA.

FDA has issued the non-objection letter for the LSP-Process in November 2013.
More approvals for P:REACT are pending.

rPELLETS/CONVERTING

1

2

3

1. CRYSTALLIZED rPELLETS
2. CAST FILM DIRECT CONVERTING
3. DIRECT CONVERTING OF FIBERS

After exiting P:REACT, the molten PET can be further converted to clear rPellets, crystallized rPellets or even directly converted to finished products.

NGR®
RECYCLING MACHINES
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P:REACT

	min [kg/h]	max [kg/h]	min [lbs/h]	max [lbs/h]
P:REACT 300	150	400	330	880
P:REACT 600	300	700	660	1540
P:REACT 1200	600	1400	1320	3080
P:REACT 2000	1400	2200	3080	4840

In addition, NGR provides all the equipment for conveying pellets such as blower, pipes, cyclones and much more.

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