BASF
The Chemical Company

Joncryl® ADR 4468

Polymeric Chain Extender for Food Contact Applications

Joncryl® ADR 4468 is a patented, multi-functional reactive polymer with an improved thermal stability versus earlier chain extenders for specific food contact applications polycondensation polymers (e.g. PET and PLA). It can also be used for the modification of other thermoplastics such as PBT, TPU, PC, PC/ABS ect.

It is a polymeric chain extender with low epoxy equivalent weight (= high number of epoxy groups per chain) that reacts with the chain ends of polycondensates and effectively increases their melt viscosity.

Joncryl® ADR 4468 can be used during processing to increase the melt strength of polycondensates to improve the processability during extrusion of films, sheets, foams, paper coatings, and blow-molded objects.
For food contact notification, see BASF Regulatory Information Sheet.

Key Features & Benefits

- Reacts and modifies polycondensation polymers
- Increases molecular weight and melt strength
- Improves hydrolytic stability
- Improved processability and accelerated polycondensation reaction

Appearance	Solid flakes
Specific gravity, 25° C	1.08
Mw	7250
T_g (°C)	59
Non-volatile by GC (%)	>99
Epoxy equivalent weight (g/mol)	310

These typical values should not be interpreted as specifications

1. Product Form

Form	Particle Size [1]/ Physical Characteristics	Description
ADR 4468 (Flakes)	2.5 – 4.0 mm mean <2% (w/w) smaller than 0.15 mm	Efficient for dry blending with cold plastics pellets of flake, or for separate feeding
Pre-compounded masterbatch (supplied by recommended masterbatcher)	Appearance will depend on pelletization and carrier resin.	Masterbatches are recommended for single screw extrusion or injection molding applications where mixing is limited.

[1] Particle size distribution may shift toward smaller particle sizes with handling due to the brittle nature of this additive.

2. Recommended dosage for Joncryl® ADR 4468

Every chain extension problem is unique and you may consult our technical service team should you need help with determining the right dosage for your specific operation. In general, the recommended initial trial dosage should be 0.2%. You may increase or decrease the dosage after your initial trial depending on the outcome and your target requirements in the following applications for different type of resins:

Resin Types
Polyesters (PET, PETG, PBT, PLA, etc.)
Polycarbonates (PC, PC/ABS)
Others (TPU etc.)

Applications
Injection molding (compound of recycled polycondensates)
Extrusion (film, sheet, tape, strap profile)
Blow molding (extrusion blow molding, ISBM of recycled polyesters)
Hydrolytic stabilization
Foam
Compatibilization (e.g. alloying of PA-PET, etc.)

3. Feeding Method

Procedure

Dry-Blending

a) Flake or masterbatch can be dry-blended with pre-dried and cold (<40ºC) plastic pellets or flakes with the aid of low shear mixer such as tumble mixer or conical mixer.

b) All solid forms of Joncryl® ADR 4468 can be mixed with other materials in a high shear mixer such as a Henschel mixer below

50ºC. Cold mixing may be aided with 0.2% of Joncryl® ADP-1200, acrylic plasticizer.

Feeding of Joncryl® ADR 4468 on a single screw extruder, twin screw extruder or kneader

a) Dry-blends prepared as in (1) can be volumetrically, gravimetrically or flood fed directly into the mixing zone of the extruder (see temperature recommendations in the Processing Conditions in Section 4.)

b) Gravimetric feed metering systems can be used to feed any solid product form in a parallel stream with the plastic directly into the feeding zone of the extruder. Belt and disc feeders are particularly recommended for the flake form.

- Single Screw Feeders – clearance of 3 to 5 mm (0.76 – 1.27 in) between the screw and the tube recommended.
- Twin-Screw Feeders – non-intermeshing spiral screw with 6 mm (1.52 in) clearance between the screw and the tube recommended. Eliminate agglomeration at the throat or feed zone by maintaining tube temperature below 80 °C.

c) Volumetric Feeders: Well calibrated feeders with variation of less than 0.5% are recommended. Clearance of 3 to 5 mm (0.76 – 1.27 in) between the screw and tube is also required to reduce fines.

Eliminate agglomeration at the throat or feed zone by maintaining tube temperature below 80 °C.

d) Side feed systems and other types of forced dosing extruders may be employed with all solid product forms, except for fine powder, to feed the products downstream. Residence time recommendations are given below in reference to downstream feeds.

e) Direct gravimetric/volumetric addition of the chain extender in any form to the plastic melt may be carried out through any suitable downstream venting or degassing port.

4. Processing Method

Procedure

Pre-drying

Pre-dry the base plastic at manufacturer's recommended conditions.
In some instances small amounts of Joncryl® chain extenders can compensate for poor/incomplete drying, thus bringing robustness and savings to your operations. For example in polyesters, degradation brought about by 100 ppm of moisture can be compensated by 0.2 % of Joncryl® ADR 4468.
Hygroscopicity: there is no evidence of bulk absorption of moisture over extended periods of time for Joncryl® ADR 4468.

- At normal conditions of temperature and relative humidity (i.e. 25°C and 50% RH) its surface reaches equilibrium saturation

through adsorption at less than 0.25% moisture.

- At extreme conditions (i.e. fine powder at 35°C and 100 % RH) its surface reaches equilibrium saturation at less than 0.50 % of moisture.

Therefore, Joncryl® ADR 4468 can generally be processed without any drying, even after long exposure to drastic conditions bringing no more than 5 ppm moisture per every 0.1% used.
In systems where moisture sensitivity is extreme, Joncryl® ADR 4468 can be dried in a desiccant dryer at 30°C for 1 hour, prior to use
Masterbatches of Joncryl® ADR 4468 should not be dried above 120°C to prevent pre-reaction within the masterbatch from happening.

Extruder Temperature Profile

When feeding solid Joncryl® ADR 4468 into the 1st zone of the extruder or injection molder, we recommend operating this zone at 20°C to 40°C lower temperature than normal. This will prevent early melting and agglomeration of the additive.

Refer to masterbatch suppliers' directions for additional information and instructions regarding how to use chain extender masterbatches.

All other zones should employ normal processing conditions as recommended by the plastic's manufacturer.

Additive Thermal Stability

Neat Joncryl® ADR 4468 has a better thermally stable than Joncryl® ADR 4368C / 4368CS. Therefore Joncryl® ADR 4468 has better chances for more strict food contact approvals.

Residence Time

Joncryl® ADR 4468 reacts quickly. Its reaction will be over 99% complete if at least 120 sec residence time is provided at 200°C in a well-mixed system. Alternatively, 30 sec residence time at 280°C will provide 99% completion. These limits accommodate most extrusion processes for the recommended thermoplastics and applications.

Maximum Process Temperature

Joncryl® ADR 4468 should not be processed at temperatures higher than 320°C (see Thermal Stability in Section 4)

Extruder pressure effects

The use of Joncryl® ADR 4468 in reactive extrusion operations produces significant increases in molecular weight of the plastic being modified. This increase in molecular weight raises the melt viscosity, which in turn raises the pressure observed in the equipment.

It is important that operators be aware of these expected pressure changes. Alarms, automatic shut-offs, screen purging set-points, and other operation variables should be adjusted to accommodate these normal and expected pressure increases.

Instantaneous pressure variations and spikes are due to large instantaneous changes in melt viscosity. At constant temperature, changes in melt viscosity are often due to variable feed rate and/or poor mixing Fluctuations in the feed rate of Joncryl® ADR 4468 larger than 10% of the target value may cause large instantaneous extruder pressure

spikes. To attain steady and consistent pressure, homogenous dry blends or robust co-feed systems are essential.

Finer screen mesh will produce even higher pressures during chain extension process.

5. Troubleshooting

In case of unexpectedly high pressure:

1. Decrease the feed rate of Joncryl® ADR 4468
2. Decrease the RPM. This decreases pressure on single screw extruders and flood-fed twin-screw extruders, and will decrease heating on starve-fed twin- screw extruders
3. Slowly increase the temperature, starting from the die and then from the last to the zone.
4. In a typical extruder with an L/D >24 normally most of the extension reaction takes place in the first half of the extruder length. In-creasing the temperature in the zones of the final half of the extruder will generally result in lower viscosity and pressure.
5. With pressure under control, increase the Joncryl® ADR 4468-C/CS feed slowly.
6. For steady operation follow recommendations given in the section 5 above.
7. Keep in mind that chain extension will always result in higher pressure at constant extruder settings.
8. In case extruder stopped on high torque caused by overdosing of Joncryl® ADR 4468, increase barrel temperature up to 320°C and purge the extruder with raw material.

6. Note

The data contained in this publication are based on our current knowledge and experience. In view of the many factors that may affect processing and application of our product, these data do not relieve processors from carrying out their own investigations and tests; neither do these data imply any guarantee of certain properties, nor the suitability of the product for a specific purpose. Any descriptions, drawings, photographs, data, proportions, weights, etc. given herein may change without prior information and do not constitute the agreed contractual quality of the product. It is the responsibility of the recipient of our products to ensure that any proprietary rights and existing laws and legislation are observed.

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