Featuring JSR’s EXCELINK Materials

1200B  1303B  1405B  1600B  1703B  1810B
1300B  1309B  1406B  1601B  1800B  1901B
1301B  1404B  1504B  1700B  1805B  1301N
JSR believes in customer sales support services.

- Our engineers will help guide you in Application Development.
- From part conception to production we can help with: Material Selection, Design, and Processing.
- We can help select the right equipment including, Drying, Mold Machine and Mold Machine Components.
- We can also help with advice on Secondary Operations and Manufacturing Cells.
- Whatever it takes to make your application become a reality we will be there for you.

Experience the excellence of EXCELINK materials!

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**INTRODUCTION**

**JSR EXCELINK Materials a new Olefinic Thermoplastic Elastomer.**

The TPE business: Thermoplastic elastomers (TPEs) have gained attention as being materials that fill the functional gap between synthetic rubbers and thermoplastic resins. Exhibiting fluidity at high temperature, TPEs can be easily molded and processed, just like thermoplastic resins. At room temperature, TPEs show rubber elastic properties.

**Thermoplastic elastomers (TPE)**, sometimes referred to as **thermoplastic rubbers**, are a class of copolymers or a physical mix of polymers (usually a plastic and a rubber) which consist of materials with both thermoplastic and elastomeric properties. While most elastomers are thermosets, thermoplastics are in contrast relatively easy to use in manufacturing, for example, by injection molding. Thermoplastic elastomers show advantages typical of both rubbery materials and plastic materials. The principal difference between thermoset elastomers and thermoplastic elastomers is the type of crosslinking bond in their structures. In fact, **crosslinking** is a critical structural factor which contributes to impart high elastic properties.

**One Key Technology of EXCELINK materials is that they are made especially for ease of injection molding.**

- **This means easy start up.**
  After drying EXCELINK accordingly the material can usually be placed directly into the hopper, fed into the barrel and screw which will produce good parts within the first few shots. It is suggested that 2 - 3 air purges are done before and after material is in the barrel.

- **Consistent polymerization of material producing uninterrupted flow of the material for shot after shot repeatability.**
  This is because of the compounding technology and polymer modification during the first stage process of the EXCELINK material.

**Other JSR EXCELINK Material Characteristics:**
- Generally will produce parts in shorter cycle times.
- Generally will produce parts that result in good aesthetics.
- Wide range of hardness. Shore 37A – 80A are available with no oil bleed.
- High melt flow rate which provides excellent adhesion strength with cured rubber.
- Good thermal adhesion with rubber in molding.
- High melt flow rate which provides excellent adhesion with extrusion TPV’s.
- Excellent surface slipperiness.
- Low COF (Coefficient Of Friction) and good durability of slipperiness.
- Keeps low COF after aging under high temperature.
- Excellent recyclability and regrind can be used at modest levels.

**This Injection Molding Guide will help the consumer process the material with ease.**

It must be noted that this manual is a guide and must be used specifically for that purpose. It is the best of our knowledge, the information contained in this publication is accurate, however we do not assume any liability whatsoever for the accuracy and completeness of such information. The analysis techniques included in this publication are often simplifications and therefore approximate in nature. More analysis techniques and/or prototype testing are strongly recommended to verify satisfactory part performance. Anyone intending to rely on such recommendations or to use any equipment, processing technique or material mentioned in this publication should satisfy themselves that they can meet all applicable safety and health standards. It is the sole responsibility of the users to investigate whether any existing patents are infringed by the use of the materials mentions in this publication. Any determination of the suitability of a particular material for any use by the user is the sole responsibility of the user. The user must verify the material meets the requirements of the particular product used. The user is encouraged to test samples of the product under the harshest conditions. Material data and values included in this publication are either based on testing of laboratory test specimens so data will fall within the normal range of properties for the intended material. We strongly recommend that users seek and adhere to the manufactures current instructions for handling each material they use. Please call 513-421-6166 for addition technical information.
This process produces a product that is compounded thoroughly with the polymer, filler and curing agent to create a material that has very little or no voids. This makes the molding process much easier producing a product that will have good aesthetics, good bonding strength, and excellent slipping surface.

Production Process of TPV

Continuous Reactive Process

**Production Process of TPV**

- **EPDM, PP, OIL, Others**
- **Crosslink Agent**
- **Twin Screw Extruder**
- **Simple Blend TEM Photograph**
- **Phase Exchanging**
- **TPV TEM Photograph**
- **PP Phase**
- **Crosslinked EPDM Particle**
- **TPV Pellets**
Because molding is so crucial to producing high quality parts, it is essential to understand the process and to select equipment which ensures consistency and efficiency. The molding process in a single-stage reciprocation screw injection machine is divided into two phases: the plastication phase, and the injection phase.

**Plastication**

The hopper feeds dried resin into the barrel. The feed section of the screw conveys the resin forward. Resin is melted by conductive heat, shear energy and the mechanical pressure of the compression zone. Molten plastic is then pressurized and conveyed through the metering zone achieving a uniform homogeneous melt. This molten melt pool forms in front of the screw. As the melt pool accumulates a sufficient shot size, it forces the screw to retract.

**Injection**

The screw moves forward pushing the molten polymer through the sprue, runners and gates into the cavities of the mold. After the injection phase is complete, the screw returns to begin the plastication phase once more. The part conforms to the shape of the mold cavity and the cooled mold solidifies the plastic into a solid form. The mold is then opened and the molded part is ejected from the mold, usually with the aid of an ejection system.
EXCELINK materials can be processed without difficulty in different types of reciprocating screw injection molding machines. Depending on the application, EXCELINK materials can be molded on horizontal or on vertical molding machines. A typical molding machine has two fundamental units. This consists of a clamping and an injection unit.

**Clamping Units**

Typical type clamping mechanisms are either hydraulic or mechanical. There are also hydro mechanical systems available. When used properly they are all suitable for processing EXCELINK materials.

**HYDRAULIC CLAMP UNIT**

**MECHANICAL CLAMP UNIT**

**Machine Tonnage**

Machine tonnage is generally figured in a given part’s dimensions, i.e.; L x W x D x 0.3 - 0.5 tons/sq. cm. (2 - 3 tons/sq. in.) Glass run channels are typically run on a machine of 50 – 100 tons. EPDM pillars are typically run on 150 – 300 ton machines.
For best results, machines should be selected so that the shot weight is approximately 50% of the machine barrels capacity. This minimizes residence time and prevents excessive thermal degradation. If a machine has a capacity that is less or more than 50% it is highly suggested to profile temperatures accordingly to shot size and machine barrel size. This is necessary to promote a homogeneous melt. For example, use additional rear zone heat for short residence time (a reverse temperature profile) and less rear zone heat for long residence time (a forward temperature profile). Remember that all conditions should be optimized or ideal for processing EXCELINK materials. Machine and process capabilities can usually be adjusted to compensate for non-ideal conditions.
A general purpose metering type screw is preferred for optimum processing of EXCELINK materials. A metering screw consists of three major sections: the feed zone, transition zone, and metering zone. The feed and metering zones usually both maintain constant root diameters. The screw slopes up in an involuted taper to the metering section which has a larger constant root diameter then the feed and transition section. Since EXCELINK materials are fast cycling, a metering screw should have the following Zone distribution, L/D ratio and Compression ratio:

**Preferred Metering Screw**

### Screw Design

**Injection Screw**

- **Overall Length**
- **Flight Length**
- **Shank Length**
- **Valve**
- **Screw Tip**
- **Metering Depth**
- **Feed Depth**
- **Outside Diameter**

- **25% Metering Zone**
- **25% Transition Zone**
- **50% Feed Zone**

**Note:** There are many resistant type materials one can choose to use for best wear. A screw made of carbon steel that is sprayed and fused with a tungsten carbide wear material is preferred for EXCELINK materials.

### NOZZLES

A simple general purpose free flow nozzle and nozzle tip with an independent heater band temperature controller is preferred for EXCELINK materials.

**General Purpose Nozzle**

- **Heating Band**
- **To Mold**
- **Cylinder Bore**

**General Purpose Internal Design Nozzle Tip**
Valves

Three Piece Screw Tip Ring Valve

For best results to enhance melt flow, a three piece screw tip assembly valve with generous passageways should be used in the injection molding process.

All components made from high quality, high purity tool steel.

Nonreturn Valves

A free flow non-return check ring valve or an internal ball check non-return valve can be used on reciprocation screw injection molding machines.

Free Flow Nonreturn Valve

Check Ring Open

Check Ring Closed

Internal Ball Nonreturn Valve

Ball-Check Open

Ball-Check Closed
It is important to dry EXCELINK materials sufficiently. Non-dried materials may have surface moisture within them. Any improper moisture levels are a common cause of processing and quality assurance problems. Undried hygroscopic materials can suffer degradation of properties. Non-hygroscopic materials should be dried to eliminate any surface moisture condensation.

**DRYING CONSIDERATIONS**

A dehumidifying desiccant drying system is preferred before and during processing EXCELINK materials. A typical drying unit is shown in the schematic illustration below.

1. A pneumatic loader drops materials into the insulated drying hopper on demand.
2. Drying begins as heated, dehumidified air enters the drying hopper, penetrating the material and carrying moisture vapor up to the return line outlet.
3. The moisture laden air passes through a clean filter.
4. A blower forces the moisture laden air through (into) on-stream desiccant cartridges.
5. This moisture is then trapped in these cartridges.
6. The dehumidified air is then reheated and delivered back to the drying hopper.
7. While the on-stream desiccant cartridges are removing moisture another set is being regenerated by a separate regeneration blower and heater.
8. The regenerated cartridges are switched on-stream as they are needed, maintaining a continuous drying process.

**Drying Equipment**

All EXCELINK materials should be dried for 2-4 hours at 60°C - 80°C (140°F - 175°F). It is highly suggested to dry materials to 0.05% or less moisture before and during molding. As stated, properly dried EXCELINK materials will process better, produce parts with good adhesion and good aesthetics. Do not over dry material as they may be difficult to process and may discolor.
MATERIAL CHARACTERISTICS & FEATURES

All EXCELINK materials are excellent injection molding grades for automotive weather seals. This includes EPDM dense bondable parts such as molded corners and end caps. They are also good for EPDM sponge bondable parts such as door seal corners. EXCELINK materials include the following outstanding features:

- Low density; JSR EXCELINK = 0.90 – 0.88
- High melt flow rate.
- High adhesive strength with cured EPDM dense and EPDM sponge parts.
- High gloss and controlling gloss possible by grain of molds.
- Good weatherability; Non blooming and low color difference.
- Hardness Shore grades from 37A – 80A.
- Low CS Grades; 1301B & 1309B.

PROCESSING PARAMETERS FOR EXCELINK MATERIALS

Distinctive Processing Temperatures +/- 20˚C (+/- 36˚F)*

<table>
<thead>
<tr>
<th>Article</th>
<th>Grade</th>
<th>Nozzle</th>
<th>Front Zone</th>
<th>Center Zone</th>
<th>Rear Zone</th>
<th>Melt</th>
<th>Mold</th>
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<tr>
<td>General (No Bonding)</td>
<td>All</td>
<td>210˚C</td>
<td>220˚C</td>
<td>210˚C</td>
<td>200˚C</td>
<td>220˚C</td>
<td>60˚C</td>
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<td>(390˚F)</td>
<td>(430˚F)</td>
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<tr>
<td>Bonding with Cured Rubber</td>
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<td>230˚C</td>
<td>240˚C</td>
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<td>220˚C</td>
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<tr>
<td></td>
<td>Grades</td>
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<td>(445˚F)</td>
<td>(430˚F)</td>
<td>(465˚F)</td>
<td>(140˚F)</td>
</tr>
<tr>
<td>Bonding with Plastic</td>
<td>All</td>
<td>220˚C</td>
<td>230˚C</td>
<td>220˚C</td>
<td>210˚C</td>
<td>230˚C</td>
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<td>(140˚F)</td>
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</tbody>
</table>

*Delta Numbers

OTHER PROCESSING PARAMETERS

Drying Time & Temperature...2 – 4 Hours @ 60˚C - 80˚C (140˚F - 175˚F)
Moisture..................................................................................................................0.05% or Less
1st Stage or Fill Pressure.........................100 - 150 BAR (1500 – 2000 PSI)
2nd Stage or Pack Pressure........................35 - 70 BAR (500 – 1000 PSI)
3rd Stage or Hold Pressure ......................20 - 40 BAR (300 – 600 PSI)
Back Pressure ..........................................................3 - 7 BAR (50 – 100 PSI)
Screw Speed.................................................................50 - 100 RPM
Injection Speed.................................2 - 4 - 6 cm/Sec (1 - 2 - 3 inch/Sec.)
Fill Time .................................................................1 - 2 - 3 Sec.
Pack Time.................................................................5 - 15 Sec.
Hold Time ...............................................................3 - 6 Sec.
Cooling Time ............................................................10 – 40 Sec.
Cycle Time ...............................................................20 – 60 Sec.
**BASIC DESIGN PRINCIPLES**

Design principles for EXCELINK materials are typical to other thermoplastic materials. They include the following steps or suggestions.

---

### Constant Wall Thickness

There can be many dimensions for given parts or applications, however most common are 0.5 mm - 1 mm. Whatever the given part or application is, it is important to maintain constant wall (nominal) thickness, including corners and ribs on those parts.

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### Radiused Corners

Radiusing all corners, inside and outside, will enhance flow and reduce stress concentration. It will also help maintain constant wall thickness in corners. Internal radius is generally ½ the nominal wall thickness.

---

### Draft Angle

Always use the maximum allowable draft angle. A minimum of 1 cm (½ inch) per side is suggested however other adequate draft factors are:

- Use more draft if there is texture on the application.
- Use more draft to reduce ejection pressure on ribs and bosses.
- Use more draft for shrinkage considerations. The material can grip the mold core as it shrinks while it cools. Damage from ejectors can result in inadequate draft.

---

**WARPAGE CONSIDERATIONS**

Because of the elastomer makeup of EXCELINK materials, warpage should not be a concern. However because any thermoplastic material may warp one should consider the following suggestions.

- Maintain uniform wall thickness.
- Balance runner systems for even filling.
- Use uniform temperatures for even cooling.
- Size gates appropriately to avoid premature freeze-off.
- Avoid molded in stress.

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**SHRINKAGE CONSIDERATIONS**

Mold or part shrinkage in TPE materials follows the basic rules of other thermoplastic materials. Shrinkage is generally anisotropic. This means that shrinkage is less in the direction of the flow (longitudinally direction) than the other direction (transversely) across the flow. Shrinkage is very material dependent and most shrinkage can be caused by the following processing variables and design features.

- Melt & Mold temperatures.
- 1st stage Injection Pressure.
- Pack & Holding Pressures.
- Injection Speed (time to/of fill).
- The flow direction of the material.
- The gate/runner design and size.
- The part or wall thickness and size.
With many thermoplastic materials proper mold design is essential. Because of the elastomer makeup, mold design is usually somewhat forgiven. Nevertheless when one designs a mold it is important to think about the type and design. This involves the use of sprues, runners, gates and venting.

**Sprues**

**TAPERED SPRUE PULLER**

A simple sprue design for single cavity molds are symmetry on circular shapes. The sprue should have sufficient draft, from 1° to 3° to minimize drag and sprue sticking. Longer sprues may require more taper (3° - 5°), as shown. The sprue diameter is usually slightly larger than the nozzle diameter. An EDM finish is acceptable for most TPE materials.

**Runners**

**TYPICAL SPRUE & FULL RUNNER SYSTEM**

Full round runners are preferred however trapezoidal runners are also acceptable. Rectangular or half round runners may be used, but they are less efficient. Generous radii should be provided in the runner system where the sprue joins the runner. A cold slug well should be added in the runner flow front. Runner length should be kept at a minimum.
MOLD DESIGN

Gates

Gate location should be chosen carefully to minimize possible part distortion or opposing effects on part dimensions due to anisotropic shrinkage. For best results, the gate should be located so as to achieve suitable flow within the gate to the ends of the part. If this is not possible the gate should be located along the position of the most critical dimension, since the shrinkage is most often anisotropic in nature. If more than one gate is needed, gates should be located in noncritical areas to minimize weld lines that occur when two flow fronts meet in the mold.

Gate Types

There are many gate types one can choose from when processing EXCELINK materials. Most depend on the application however tunnel or submarine types are preferred. A wide angle of 60° is preferred on a submarine gate to provide clean break in small size gate area.

TYPICAL SUBMARINE GATE

Venting

Vent wherever possible, at parting lines, runners, ejector pins, ribs, etc. Venting is extremely necessary to prevent the burning of material from the condensed air that builds up during the rapid mold filling qualities of EXCELINK materials. Venting is particularly critical at weld (knit) lines and the last area of fill on the part.

Vent Size

Vent size is highly dependent on the part thickness. Generally, vent sizes are 0.01 mm deep or 0.05 mm deep.

Mold Construction

When choosing the proper tool steel for EXCELINK materials, one must consider the following.

- For a high volume project a mold constructed with a H-13 is preferred.
- For a low to medium volume project a mold constructed with P-20 should be sufficient.
- For a prototype to very low volume project a mold constructed of Aluminum should be sufficient.

Note: It is strongly recommended to use prototype tooling in the beginning of any application. Contact a mold/design engineer before beginning to make both the prototype and the final tool.
To produce high-quality consistent parts with EXCELINK materials, proper storage and handling efforts should be made. Since EXCELINK materials are packaged well it is important to maintain the integrity of that package. Torn or damaged bags may acquire moisture within the material. Materials shipped in gay lords should be covered until and during use. Storing EXCELINK materials in warm and dry conditions are preferred. Cold conditions can cause surface condensation while warm humid conditions can lead to moisture absorption. EXCELINK materials should be protected from any type of moisture conditions.

**NOTE:**
EPDM Pillars that get co-injected with glass run corners are best molded in conjunction with each other. If EPDM Pillars are molded in advance to the glass run corners it is preferred that the pillars are kept in warm and dry areas. One will get the best adhesion, aesthetics and over-all part quality if this is done.

**SAFETY PRECAUTIONS FOR JSR EXCELINK MATERIALS**

At JSR we believe that safety is #1 when processing any materials. So when processing plastic materials, one should follow the safety precautions listed below.

1. Safety glasses should be worn by all personnel in the molding area.

2. Overheating the material (usually caused by excessive temperatures or holdup times) should be avoided.

3. The molding machine should not be left unattended. If molding is stopped for more than a few minutes, the machine should be purged. If the molding operation is stopped completely purge the machine and shut down the equipment accordingly.

4. The Safety Data Sheets (SDS) should be studied carefully by all molding personnel.

5. Purging materials can cause fumes. To minimize human exposure and properly limit environmental release, appropriate venting systems should be used. For most materials, immediate quenching of purged materials in water (with adequate precautions to avoid steam burns) will minimize fuming into the environment.

6. To the best of our knowledge the information contained in this publication is accurate; however, we do not assume any liability whatsoever for the accuracy or completeness of such information. Moreover, there is a need to reduce human exposure to many materials to the lowest practical limits in view of possible long-term adverse effects. To the extent that any hazards may have been mentioned in this publication, we neither suggest nor guarantee that such hazards are the only ones which exist. We recommend that anyone intending to rely on any recommendation or to use any equipment, processing technique, or material mentioned in this publication should satisfy themselves that they can meet all applicable safety and health standards. We strongly recommend that users seek and adhere to the manufacturers or suppliers current instructions for handling each material they use. Infringement of any patents is the sole responsibility of the user.
Most processing problems are caused by easily corrected conditions, such as inadequate drying, incorrect temperatures and/or pressures, etc.

The solutions given in the following pages are prioritized according to their simplicity, cost, and/or time savings, depending on the problem. It is suggested that the solutions should be tried in the order in which they are listed. Most solutions or changes should improve a molder’s productivity and efficiency.

### SINKS & VOIDS

**Solutions:** Pre-Dry the material 2 – 4 Hours @ 60 ºC - 80 ºC (140°F - 175°F).
- Moisture level should be below 0.05% or less.
- Increase screw back pressure 1 bar (15 psi) until screw recovery is consistent.
- Decrease cushion by 3.2 mm (0.125 inch) until part is fully packed out.
- Keep mold temperature uniform on the mold surface.
- Lower mold temperature will help with sinks.
- Raise the mold temperature to help with voids.
- Increase the injection pressure for sinks and voids.
- Increase the pack time by 1 second increments.
- Use a fast injection speed.
- Decrease the melt temperature by 10 ºC (20 ºF)* increments.
- Increase the size of the sprue, runner and gate.
- Relocate the gate in the thicker section of part.

### WEAK BOND STRENGTH (ELIMINATING SPLITS)

**Solutions:** Pre-Dry the material 2 – 4 Hours @ 60 ºC - 80 ºC (140°F - 175°F).
- Moisture level should be below 0.05% or less.
- Use fresh cut EPDM or TPV inserts.
- Increase the shot size.
- Decrease injection time.
- Use a fast injection speed.
- Keep mold temperature uniform on the mold surface.
- Increase the mold temperature by 10 ºC (20 ºF)* increments.
- Increase the melt temperature by 10 ºC (20 ºF)* increments.
- Mold EPDM or TPV pillars in conjunction with glass run corners.

### DELAMINATION

**Solutions:** Pre-Dry the material 2 – 4 Hours @ 60 ºC - 80 ºC (140°F - 175°F).
- Moisture level should be below 0.05% or less.
- Check for any contamination and remove it.
- Increase the injection speed.
- Purge the machine with “neat” Polypro or like material and restart the process.

*Delta Numbers*
**SHORT SHOTS, PIT MARKS AND SURFACE Ripples**

**Solutions:**
- Pre-Dry the material 2 – 4 Hours @ 60°C - 80°C (140°F - 175°F).
- Moisture level should be below 0.05% or less.
- Increase the fill or 1st stage injection pressure by 7 bar (100 psi) increments.
- Maintain a proper cushion and increase/decrease feed as necessary.
- Increase the pack time by 1 second increments.
- Increase the pack pressure by 7 bar (100 psi) increments.
- Make sure the part is packed out.
- Decrease injection time.
- Increase the injection speed.
- Keep mold temperature uniform on the mold surface.
- Increase the mold temperature by 10°C (20°F)* increments.
- Increase the melt temperature by 10°C (20°F)* increments.
- Check the vents for blockage (trapped gas prevents the part from being filled).
- Increase the size of the sprue, runner and gate.

**FLASHING**

**Solutions:**
- Pre-Dry the material 2 – 4 Hours @ 60°C - 80°C (140°F - 175°F).
- Moisture level should be below 0.05% or less.
- Check the mold for obstructions.
- Check to see that the mold is closed and clamped properly.
- Check the parting line of the mold for wear.
- Check the press platens for parallelism.
- Move the mold to a larger press.
- Decrease the fill or 1st stage injection pressure by 7 bar (100 psi) increments.
- Maintain a proper cushion and increase/decrease feed as necessary.
- Decrease the pack time by 1 second increments.
- Decrease the pack pressure by 7 bar (100 psi) increments.
- Decrease the melt temperature by 10°C (20°F)* increments.
- Shorten the overall cycle time by 1 – 3 second increments.
- Open the gate.

**SPRAY MARKS, SILVER STREAKS AND SPLASH MARKS**

**Solutions:**
- Pre-Dry the material 2 – 4 Hours @ 60°C - 80°C (140°F - 175°F).
- Moisture level should be below 0.05% or less.
- Check for any contamination and remove it.
- Check to see if the material is drooling.
- Lower the nozzle temperature by 10°C (20°F)* increments.
- Increase the mold temperature by 10°C (20°F)* increments.
- Decrease the injection speed.
- Decrease the melt temperature by 10°C (20°F)* increments.
- Shorten the overall cycle time by 1 – 3 second increments.
- Open the gate.

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With chemistry, we can.