

# PETROTAT's Solutions

For Petrochemical  
Purification



## **Selective Adsorbents**

For contaminant removal in  
olefin and polymer processes



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# Introduction of Pursorb™ Adsorbents

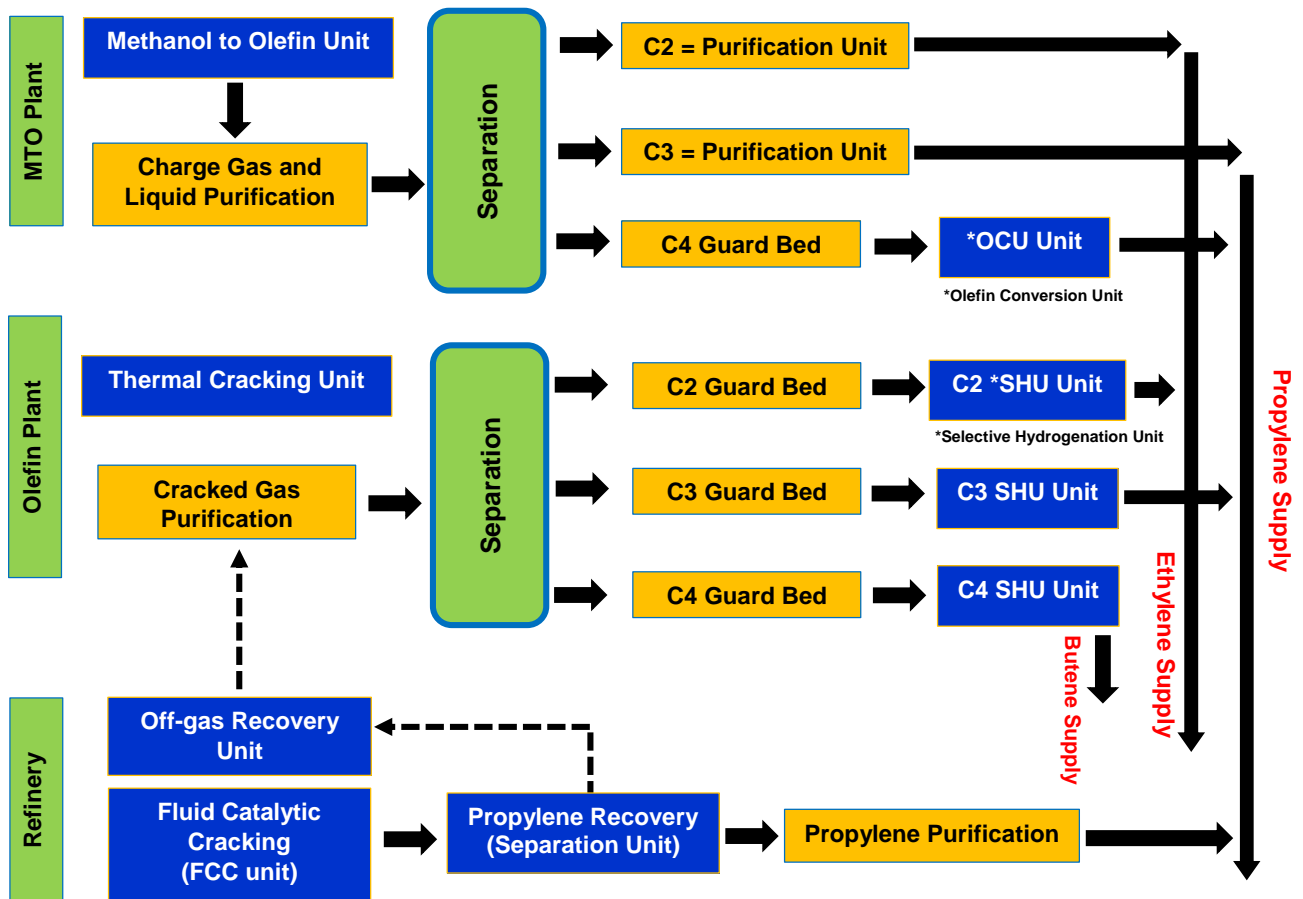
Ethylene and Propylene producers have faced the challenge of contaminants for decades. As catalyst technology in polymers production advances, the need for high-purity olefin process streams has become even more critical. The sensitivity to deactivating the new generation of high activity/yield polymerization catalysts currently applied in the production of polyethylene, polypropylene and polystyrene mandates the removal of all trace of contaminants in the feed streams to ultra-low effluent specifications.

Important contaminants include  $\text{H}_2\text{O}$ ,  $\text{CO}_2$ ,  $\text{COS}$ ,  $\text{H}_2\text{S}$ ,  $\text{NH}_3$ , oxygenated hydrocarbons (alcohols, aldehydes, ketones, peroxides, ethers, etc.) and even  $\text{AsH}_3$ ,  $\text{PH}_3$ . Selective adsorbents, both molecular sieve and modified alumina-based adsorbents, have been successfully used to help olefin producers manage their operations as contaminated feeds and increasingly sensitive polymerization catalysts continue to offer them rising challenges. Ultra-low effluent specifications for these concerned contaminants are attainable with the use of Pursorb™ selective adsorbents in either a regenerative or non-regenerative operating mode.





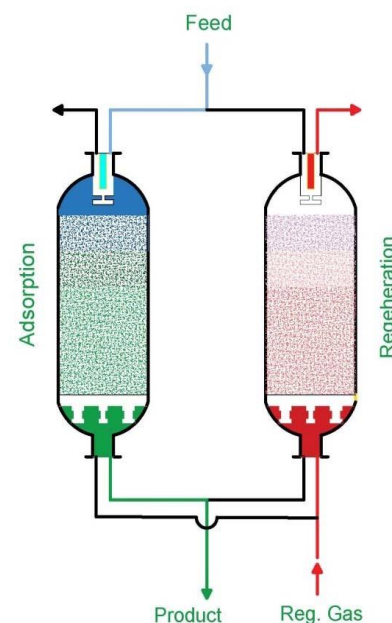
# Applications of Selective Adsorbents in Olefin Purification Fields



# Adsorption Technology for Deep Removal of Contaminants

Solid bed adsorption is the preferred separation technology for the removal of contaminants traces (typically polar or polarizable) from olefin. Petrotat molecular sieves, promoted activated alumina, and metal oxides-based adsorbents have the advantage of being able to operate in reactive environments without special processing steps. They are capable of removing detrimental impurities to extremely low levels to avoid endangering plant equipment, poisoning sensitive downstream catalysts and achieve design throughput.

The process typically involves passing the contaminated stream through one or more beds at ambient temperature to remove (adsorb) the contaminants, while simultaneously, heating a previously contaminant loaded bed with hot gas at a high temperature (250-290°C) to desorb the contaminants. Then, the hot bed is cooled and ready for the next adsorption step. In recent years there has been a growing need for the removal of water and other contaminants in ethylene and propylene production.



## Contaminants Removal Through Adsorption Technology

| Family of Contaminant       | Contaminant   | Contaminants Found resource                      | Typical Product | Regenerative Mode        |
|-----------------------------|---|--|-----------------|--------------------------|
| <b>Oxygenated Compounds</b> | Water   | Ethylene<br>Propylene<br>Co-monomers<br>Solvents | 3A-EPG          | Regenerate               |
|                             | CO <sub>2</sub>   |  | AA-01Z          | Regenerate               |
|                             | Alcohols, Ketones, Aldehydes, Ethers, Carbonyls Peroxides | Propylene<br>Co-monomers<br>Solvents             | MS-13Z          | Regenerate               |
|                             | CO, O <sub>2</sub>  | Ethylene<br>Propylene<br>Co-monomers             | C-18            | Non-Regenerate           |
| <b>Sulfur Compounds</b>     | H <sub>2</sub> S COS                                      | Ethylene<br>Propylene<br>Co-monomers<br>Solvents | AA-01Z          | Regenerate               |
|                             | Mercaptans, Sulfides Disulfides                           | Propylene<br>Co-monomers<br>Solvents             | MS-13Z 13X-PG   | Regenerate<br>Regenerate |
| <b>Nitrogen Compounds</b>   | Ammonia<br>Amines<br>Nitriles                             | Propylene<br>Co-monomers<br>Solvents             | MS-13Z 13X-PG   | Regenerate<br>Regenerate |
| <b>others</b>               | Arsine & Phosphine  | Ethylene<br>Propylene                            | C-98            | Non-Regenerate           |
|                             | Mercury   |  | MR-535          |                          |

# Be **Confident** of Pursorb™ Adsorbents for Olefin Purification

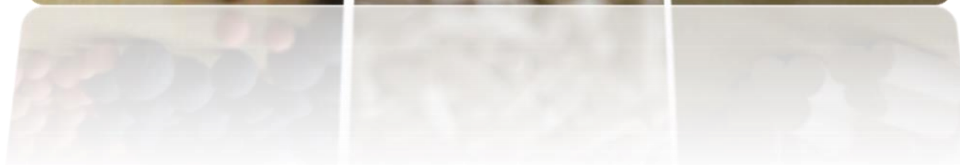
From 2012, PETOTAT's Adsorbents and Catalysts department have been focusing on the development of molecular sieves and other kinds of adsorption technology. We are pioneer in development of olefin purification adsorbent in Iran. Confidence also comes from our procedure of supplying adsorbents. For the aim of providing suitable products to meet specific production requirements, we control all aspects of product development from design to packaging and quality control. We offer highly reliable technical service.

## Value offered by Petrotat's broad olefin purification products range:

- ◆ Highly effective removal of a wide range of contaminants to even ppb level.
- ◆ Complete purification solution target on customized process.
- ◆ Modified surface activity for safe olefin process.
- ◆ Long lifetime and easy operability.
- ◆ Outstanding technical support and after sales service.

## Petrotat Olefin Purification Adsorbents:

- ◆ **Pursorb™** Molecular sieves and Modified Activated Alumina.
- ◆ **Pursorb™** Metal Oxide-based Adsorbents.



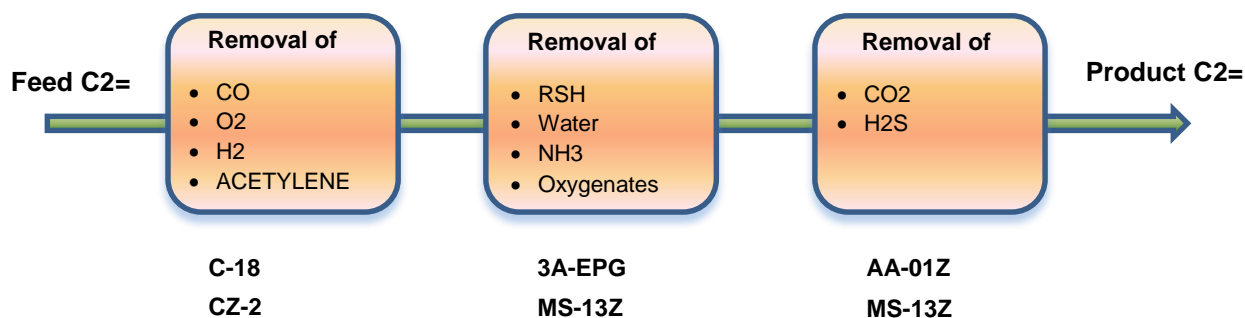
# Polyethylene Production

**Polyethylene (PE)**, which is the most common polymer in the world, mostly produced in slurry, gas phase fluidized bed reactor or combination of both processes in series (such as Spherilene and Borstar processes). Depending on its melting point, the PE is divided into several categories: low, medium and high density, each class with specific industrial applications. It occurs in the following forms: high density polyethylene (HDPE), LLDPE (linear low-density polyethylene), MDPE (medium density polyethylene), HMWPE (high molecular weight polyethylene).

To assure ideal catalytic activity of these new generation metallocene catalyst as well as the latest Ziegler-Natta type catalyst, the olefin feed and co-monomer streams must be free of contaminants, which can bond to the transitional metal groups thereby deactivating the catalyst. Depending on the source of the feed ethylene stream (olefin plant steam cracker of ethane, propane or naphtha, FCC unit, or MTO process) to a polyethylene plant, potential contaminants can include H<sub>2</sub>O, CO<sub>2</sub>, H<sub>2</sub>S, CO, O<sub>2</sub>, CH<sub>3</sub>OH, NH<sub>3</sub> and acetylene. Likewise, the comonomer feed stream (butane-1, hexene-1, octane-1, dienes and branched olefins) can be contaminated with H<sub>2</sub>O, H<sub>2</sub>S, CO<sub>2</sub>, COS, mercaptans and various oxygenated hydrocarbon compounds (alcohols, aldehydes, ketones, peroxides, ethers, etc.). The streams of polyethylene processes utilizing solvents (cyclohexane, isobutane, hexane, etc.) and reaction controlling gases (H<sub>2</sub>, N<sub>2</sub>) must be purified.

These contaminants can be removed by Petrotat **Pursorb™** Selective adsorbents to protect polymerization catalysts as follows:

## Petrotat Adsorbents Portfolio for Ethylene purification



## Attainable contaminant effluent specifications

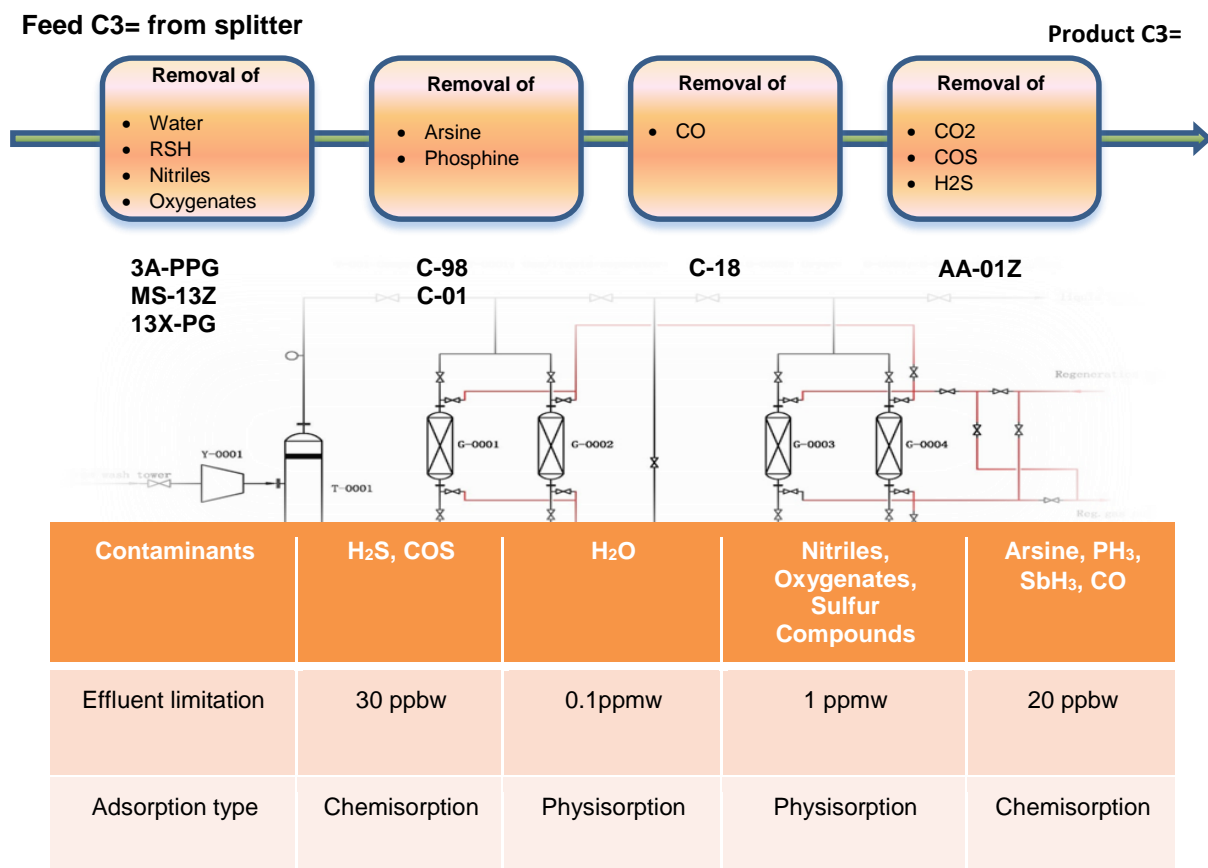
| Contaminants        | H <sub>2</sub> O, H <sub>2</sub> S, COS, | CO <sub>2</sub>         | NH <sub>3</sub> , Oxygenates, Mercaptans | CO, O <sub>2</sub> , H <sub>2</sub> |
|---------------------|--|-------------------------|--|-------------------------------------|
| Effluent limitation | 0.1 ppmv                                 | 0.2 ppmv                | 1 ppmv                                   | 20 ppbv                             |
| Adsorption type     | Physi and Chemisorption                  | Physi and Chemisorption | Physisorption                            | Chemisorption                       |

# Polypropylene Production

**Polypropylene (PP)** is produced by solution polymerization, hydrocarbon slurry, propylene slurry, gas phase and hybrid liquid/gas phase processes. Depending on the source of the feed ethylene stream (olefin plant steam cracker of ethane, propane or naphtha, FCC unit, or MTO process) to a polyethylene plant, potential contaminants can include H<sub>2</sub>O, H<sub>2</sub>S, COS, CS<sub>2</sub>, mercaptans, miscellaneous sulfides and disulfides, NH<sub>3</sub>, miscellaneous amines, amides and other nitrogen-based compounds, oxygenated hydrocarbons, AsH<sub>3</sub>, and PH<sub>3</sub> if sourced from a petroleum refinery FCCU or olefin plant steam cracker. If propylene comes from MTO plant, potential contaminants may mainly include H<sub>2</sub>O and oxygenated hydrocarbons, such as CO, O<sub>2</sub>, Alcohols and Ethers. The feed ethylene stream to polypropylene production processes can also contain the contaminants detailed in the previous section.

Ziegler-Natta and metallocene SSCs activity in polypropylene processes can be assured via removal of these contaminants with selective adsorbents as follows:

## Petrotat Adsorbents Portfolio for Propylene purification





# Petrotat Pursorb™ Adsorbents at a Glance



| Adsorbents       | Shape   | Application   |
|------------------|---------|---|
| Pursorb 3A-EPG   | Pellets | Deep dehydration from ethylene with excellent dynamic water capacity and very low hydrocarbon co-adsorption.  |
| Pursorb 3A-EPG-2 | Pellets | with optimized pressure drop, Deep dehydration from ethylene, appropriate dynamic water capacity and very low hydrocarbon co-adsorption.  |
| Pursorb 3A-PPG   | Pellets | Deep dehydration from propylene with excellent dynamic water capacity and very low hydrocarbon co-adsorption.   |
| Pursorb AA-200   | Beads   | Superior water adsorption capacity when applied at high inlet H <sub>2</sub> O concentrations.  |
| Pursorb AA-01Z   | Beads   | COS, CO <sub>2</sub> , H <sub>2</sub> S and CS <sub>2</sub> removal from hydrocarbon streams and industrial gas.  |
| Pursorb MS-05Z   | Beads   | Specially developed for Removal of water and methanol from unsaturated hydrocarbon streams, with very low heat release of adsorption.   |
| Pursorb MS-13Z   | Beads   | <ul style="list-style-type: none"> <li>Alcohols, aldehydes, ketones, ethers, and various carboxylic acids removal from liquid hydrocarbon feed streams.</li> <li>Removal of oxygenates, mercaptans, sulfides and disulfides from C<sub>4</sub> raffinate streams.</li> <li>Oxygenated organic compound removal from feed monomer, feed comonomer, and recycle solvent streams in polymer production processes.</li> </ul> |
| Pursorb 13X-PG   | Beads   | Dehydration and Oxygenated organic compound removal from feed monomer, feed comonomer, and recycle solvent streams in polymer production processes.   |

| Adsorbent       | Shape  | Active Components          | Application  |
|-----------------|--------|----------------------------|--|
| Pursorb C-98-I  | Beads  | CuO                        | Removal of traces of arsine, phosphine, COS, H <sub>2</sub> S, and other reactive compounds from Unsaturated hydrocarbons in vapor or liquid phase.                                |
| Pursorb C-98-II | Beads  | PbO                        | Removal of traces of arsine, phosphine, COS, H <sub>2</sub> S, and other reactive compounds from saturated hydrocarbons in vapor or liquid phase, with ultra-low outlet at 2 ppbw. |
| Pursorb 513-1   | Beads  | MnOx                       | Catalytic removal of O <sub>2</sub> , H <sub>2</sub> , Sulfur compounds and others from ethylene, with effluent limitation at 100 ppbw.  |
| Pursorb C-01    | Tablet | Ag                         | Removal of traces of arsine, and other reactive compounds from Cracked gas or liquid, with 1 ppbw outlet limitation.   |
| Pursorb C-18    | Tablet | CuO, ZnO                   | Catalytic removal of CO, H <sub>2</sub> , Sulfur compounds and others from ethylene, with effluent limitation at 100 ppbw.   |
| Pursorb CZ-1    | Tablet | CuO, ZnO, ZrO <sub>2</sub> | Removal of CO from gas or liquid Unsaturated hydrocarbons streams at ambient temperatures, with effluent limitation at 30 ppbw.  |
| Pursorb CZ-2    | Tablet | CuO, ZnO, CeO <sub>2</sub> | Removal of CO from gas or liquid unsaturated hydrocarbons at ambient temperatures, with effluent limitation at 10 ppbw.  |
| Pursorb MR-535  | Beads  | CuS                        | Removal of Hg from gas or liquid Unsaturated hydrocarbons at ambient temperatures, with effluent limitation at 10 ppbw.  |



Pellets



Tablet

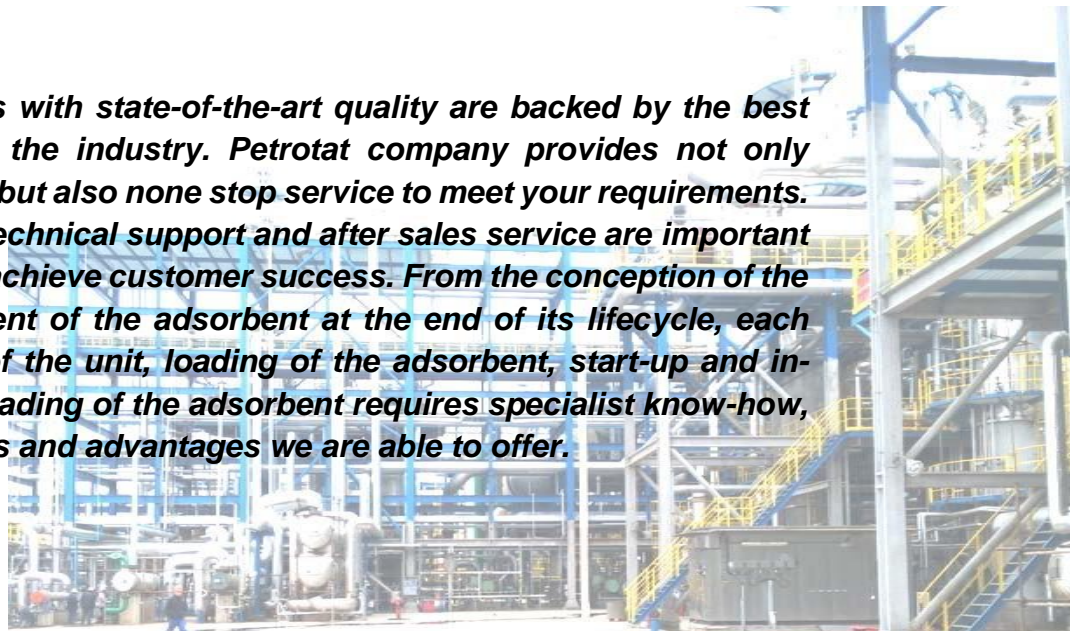


Beads

# We understand the feeling of customer

Outstanding and comprehensive customer service

**Pursorb™ adsorbents with state-of-the-art quality are backed by the best technical support in the industry. Petrotat company provides not only superior adsorbents, but also none stop service to meet your requirements. We understand that technical support and after sales service are important advantages that can achieve customer success. From the conception of the unit to the replacement of the adsorbent at the end of its lifecycle, each stage – conception of the unit, loading of the adsorbent, start-up and in-process control, unloading of the adsorbent requires specialist know-how, which is added values and advantages we are able to offer.**







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## About Us

PETROTAT is one of the largest adsorbents suppliers in Iran. Stable quality and professional technique service are our sign which wins all of our consumers' reputation. To ensure our consumers' product setup to stably and efficiently work, PETROTAT helps to consumer to select right product and we also could help customers for designing the process. Based on the idea "Technology-based trade, Quality-based survival" PETROTAT supplies the highest quality of products and technical support.

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