SMOOTH SLIDING

Consulting company providing engineering services on issues related to sliding bearings

Polytetrafluoroethylene (PTFE) as Solid Lubricant

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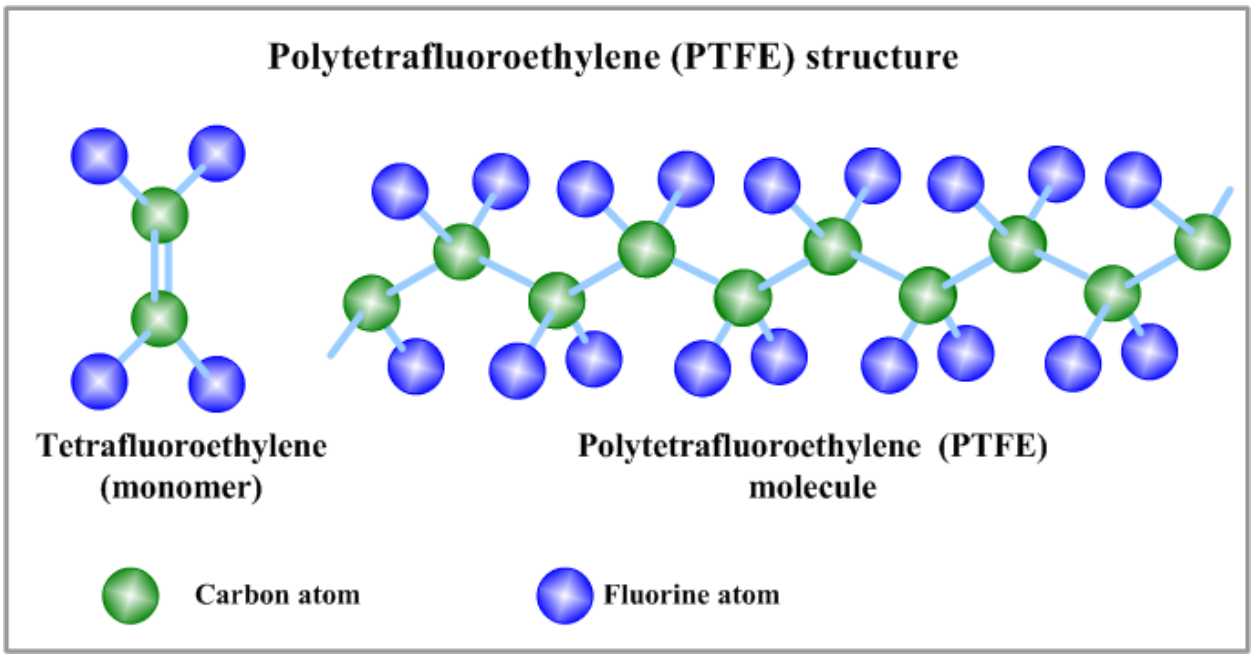
Polytetrafluoroethylene (PTFE) is a crystalline fluoropolymer consisting of long parallel macro-molecules, each of them is made of a carbon chain surrounded by fluorine atoms forming a linear repeating structure **-CF_2-CF_2-CF_2-**.
The monomer molecules (tetrafluoroethylene) have the structure **$F_2C=CF_2$**.

The fluorine atoms covering the carbon chain protect it from chemical activity.
They also repeal other PTFE molecules and molecules of other substances resulting in high chemical resistance and exceptional non-sticking properties of polytetrafluoroethylene.



Due to very weak bonding between neighboring PTFE molecules the may slide easily along each other at low shear stresses similar the hexagonal planes of **solid lubricants with lamellar structure** (graphite, molybdenum disulfide and boron nitride (BN)).
PTFE is capable to withstand relatively high compression strength in the direction perpendicular to the sliding movement resulting in good load carrying capacity.

Polytetrafluoroethylene is a solid lubricant relating to the class of **organic lubricants with chain structure of the polymeric molecules**.

Coefficient of friction of PTFE is lowest of all solid lubricants. It varies within the range 0.02 - 0.1. Due to non-stick properties of polytetrafluoroethylene there is very small difference between the static and dynamic coefficients of friction.
Coefficient of friction of PTFE does not depend on the environment. It is as low in vacuum as in oxidizing, non-oxidizing moist and dry atmospheres.
Application of polytetrafluoroethylene in open air at elevated temperatures is limited to 554°F (290°C).

The main disadvantages of PTFE:

- low melting point
- low thermal conductivity
- relatively low load carrying capacity (as compared to boron nitride, molybdenum disulfide and graphite)

Because of the disadvantages polytetrafluoroethylene is used in light low speed applications.

As a solid lubricant PTFE is used in the following forms:

- As a friction modifier added to lubrication oils
- PTFE particles dispersed throughout sintered bronze matrix (sliding bearings)
- Components of polymer based composite anti-friction coatings
- Second phase particles of metal based composite anti-friction coatings
- Polymer Matrix Composites with PTFE matrix reinforced by glass fibers or carbon fibers (better mechanical properties, higher thermal conductivity, better wear resistance)
- Polymer matrix composites reinforced by carbon fibers, glass or steel interwoven with PTFE fibers