International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 06 | June 2020 www.irjet.net p-ISSN: 2395-0072

Extended Applications of PTFE

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Abstract – *PTFE (polytetrafluoroethylene) is synthetic fluoropolymer and is an engineered form of tetrafluoroethylene widely bifurcated into loading nano and micro fillers in it for different purposes. It is widely used in automobile, electrical, mechanical as well as in healthcare industries due to its incredibly versatile properties. Through this article, we would like to explore some other areas where we can replace existing material with PTFE for the overall better performance. PTFE has been in the market for more than sixty years, but it is still finding new applications at the frontiers of the chemical and combustion industries with its unique range of very low and high service temperatures, chemical resistance, and low coefficient of friction.*

Key Words: **polytetrafluoroethylene, coefficient of friction, synthetic, fillers.**

1. INTRODUCTION

Teflon is also known as polytetrafluoroethylene (PTFE) and it is a synthetic polymer. This means it is a man-made chemical made up of two main atoms: carbon and fluorine.

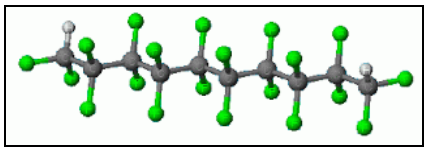

Fig -1: 3D structure of Teflon, -(CF_2CF_2)-

It is made by polymerizing many tetrafluoroethylene (TFE) molecules together. Polymerization is a process in which molecules are combined into long strands. Polytetrafluoroethylene (PTFE) is the base thermoplastic material for manufacturing expanded polytetrafluoroethylene (ePTFE) membranes and other products[1,5].

1.1 Existing uses of PTFE:

It is also a high performance engineering plastic which is widely used in engineering field, medical field as well as for manufacturing toys, small gears, wheels, cams, seals and so many products. Its use as sliding bearing material is now a days increasing due to its properties such as low coefficient of friction, high resistivity against temperature, chemically neutral, self-lubricating, light weight etc. Its costs low compared with metallic sliding bearing materials. PTFE's remarkable extreme properties include resistance to nearly all commercial chemicals and steady mechanical endurance in the temperature range of - 260°C to 260°C. The major drawback to this plastic is its relatively low strength as compared to other engineering plastics. Consequently, it has a tendency to flow under modest tensile or compressive loads, and this tendency is aggravated as the temperature increases [1]. Some PTFE types are made by adding fillers in it (such as carbon, zinc, PEEK, graphite, glass fibers, aluminum, MoS2 and bronze etc.) in order to improve its functional properties and wear resistance[4]. Teflon does not get wet which avoids rusting of pipes. It can also withstand an extreme temperature which is another reason that it is used to make pipes so that they do not burst if exposed to high temperatures. PTFE has been recently used in manufacturing of break wires of mountain dirt bikes by *BTWIN* Company. They have provided a layer of PTFE to reduce friction to the existing galvanised steel braking cable.

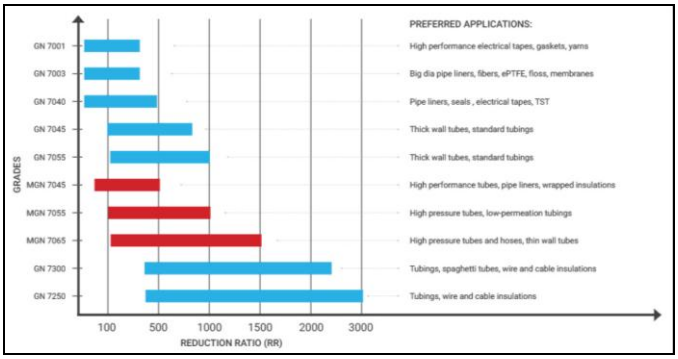

Fig -1.1: Various PTFE grades and their applications [2]

1.2 Properties:

Property	Value
Density	2200 kg/m3
Glass temperature	114.85 °C (238.73 °F; 388.00 K)
Melting point	326.85 °C (620.33 °F; 600.00 K
Thermal expansion	112–125×10−6 K−1
Thermal diffusivity	0.124 mm2/s
Young's modulus	0.5 Gpa
Yield strength	23 MPa
Bulk resistivity	1018 Ω·cm
Coefficient of friction	0.05–0.10
Dielectric strength	(1 MHz) 60 MV/m

Fig -1.2: PTFE properties

2. Extended Applications of PTFE:

2.1 Musical instruments:

Various musical instruments such as Guitar, Violin, Viola, and Cello and as well as Indian classical instruments like Sitar require tuning multiple times in order to set its sound frequency. During the tuning process, friction occurs between metallic strings and the part of the instrument, on which the strings are being rested. Also, more efforts needed to turn the tuning knobs by hands which ultimately consumes more time. This repeated friction while its use, may lead to wear in strings.

In order to make this tuning effortless and smooth, the material of such small part can be replaced by PTFE with glass and MoS2 as added fillers in it. Glass fiber and MoS2 will increase the wear resistance of pure PTFE and this unique mixture will cause less wear of the part itself [3]. Stainless steel is considered as a major component for string manufacturing. PTFE with added fillers will provide solid lubrication to the metallic strings during their sliding contact. Hence the SS and PTFE combination will improve the overall performance of the instrument by reducing wear and tear.

Fig -2.1: The part of a guitar having a consistent contact with strings during the tuning

2.2 Sliding drawers, windows and doors:

Generally we get metallic channels as sliders for drawers, windows and doors. We usually come across some major issues such as rusting and wear of contact surfaces which lead to the blockages during operating the drawers. In some cases, the steel ball bearings come out from the whole assembly.

Fig -2.2: Slider assembly for drawers

Hence, we can use small strips of PTFE material at the contact surfaces by replacing the ball bearings. This will further reduce the complexity of the assembly. In addition, PTFE spray can be used to prevent the surface from rusting [6].

2.3 Carrom Board surface coating:

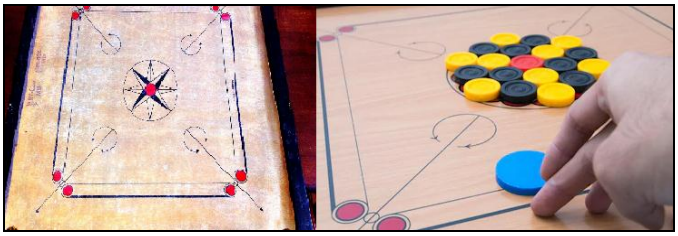

Fig -2.3: Carrom board

Over a period of time, carrom surface gets affected by dust, stains and scratches. Teflon coatings are also available for wood and furniture in the form of sprays such as *DuPont Teflon Non-Stick Dry-Film Lubricant Aerosol Spray 10 Oz* and *Weicon Teflon spray* [6]. It can be applied on carom surfaces prior to painting. This will provide waterproof surface and longer life to it by keeping the surfaces away from dirt, moisture and stains.

2.4 Seat adjustment:

Seating assembly structure is shown in below image. While adjusting the seat position, user operates the lever to move seat forward or backward. The outer track and sliding rails are made up of steel which are in constant meshing with each other creating frictional contact. It results into wearing of operational surface.

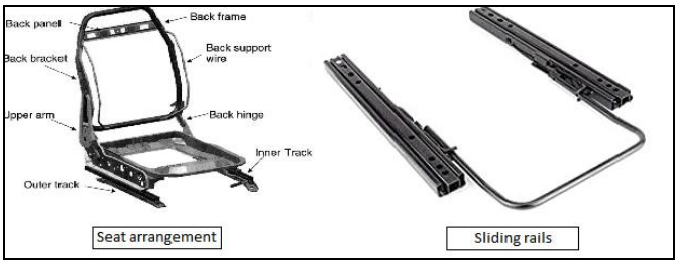

Fig -2.4: Four wheeler seat structure

To create smooth sliding motion, we propose to apply PTFE coat over the contact surfaces of sliding rails.

Due to low coefficient of friction and wear resistance, it will additionally enhance their life by keeping the surfaces safe from dust and scratches. It is also available in the forms of spray [6].

3. CONCLUSION

Teflon has a wide range of remarkable properties which can be helpful to improve the performance of some existing systems. In above examples we tried to improve the functioning and durability by replacing conventional materials with PTFE.

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