Case Study
Butterfly Valves in the Mining Industry

Application:	Mining
Location:	Worldwide
Year:	N/A
Instrumentation involved:	Butterfly Valves
Provided Solution:	PFA disc + PTFE Liner

Description:

In the mining industry, minerals and other geological materials are extracted from an ore body, vein or other deposits. After the concentration of minerals, they are further processed either through hydrometallurgical, electrometallurgical or pyrometallurgical processes.
In leaching, smelting, solvent extraction and electrowinning, valves are exposed to very aggressive chemicals that can easily damage them, and drastically reduce their lifespan. Mines require high quality, reliable and robust valves in demanding applications to fulfil the needs of the mines as well as the investors.

Metals like zinc, copper, platinum etc. are solved out from grinded stone with sulphuric acid.
During this process the butterfly valves are exposed to extremely high and aggressive conditions:

The operation conditions are not always under control; therefore the pressure and concentration are not on a constant level (concentration 40-50%, temp. 40-70°C, press. max. 5bar).

Due to the continuous repairs of the butterfly valves the mines often run just at half the capacity only.

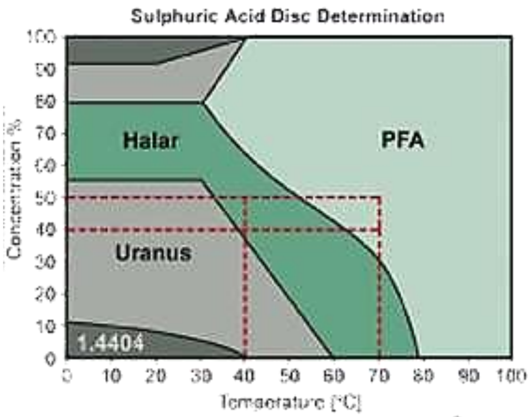

Figure 1.1 Lug type Butterfly valve damaged by the hard environment of a mining application

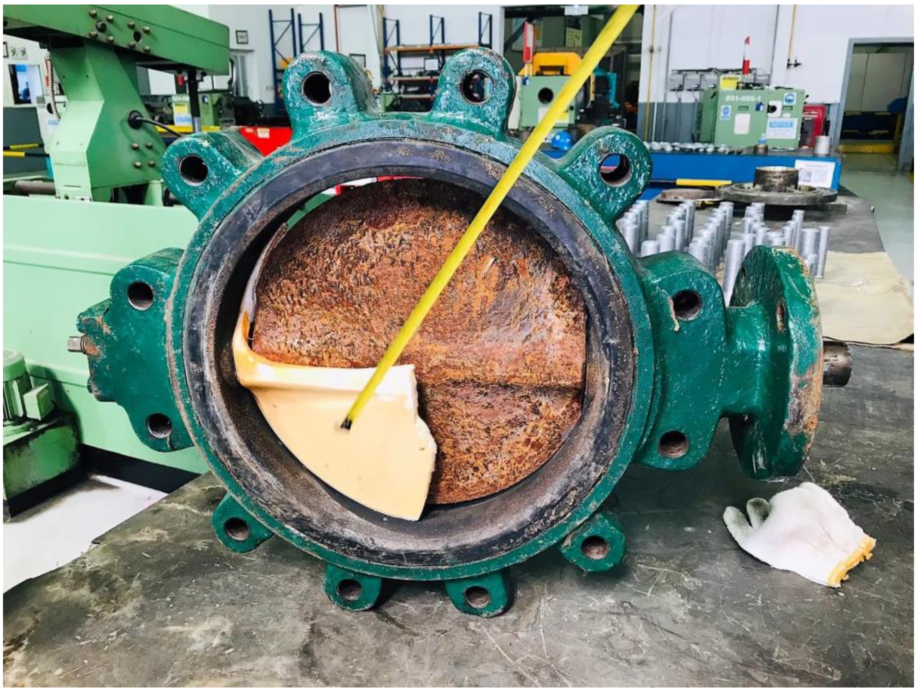

Figure 1.2 Lug type Butterfly valves with damaged and corroded disc due to the aggressive chemicals and slurry of a mining application

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valveIT Solution:

ValveIT's knowledge gained in various processes of the mining sector through several successful installations,results in a complete & cost-effective valve package including PTFE-lined and loose rubber lined butterfly valves, PTFE-lined ball valves as well as actuators. In particular, the Bianca butterfly valve with ductile iron body, PFA overmolded disc and PTFE liner has proven itself in the most demanding mining applications known around the world. With the innovative design and superior quality that ensures longevity, prevents damage and unexpected failure. The Bianca butterfly valve can offer maximum plant availability, reducing total cost of ownership, thus increasing profitability overall. The different operating conditions of the mining industry are so covered consequently.

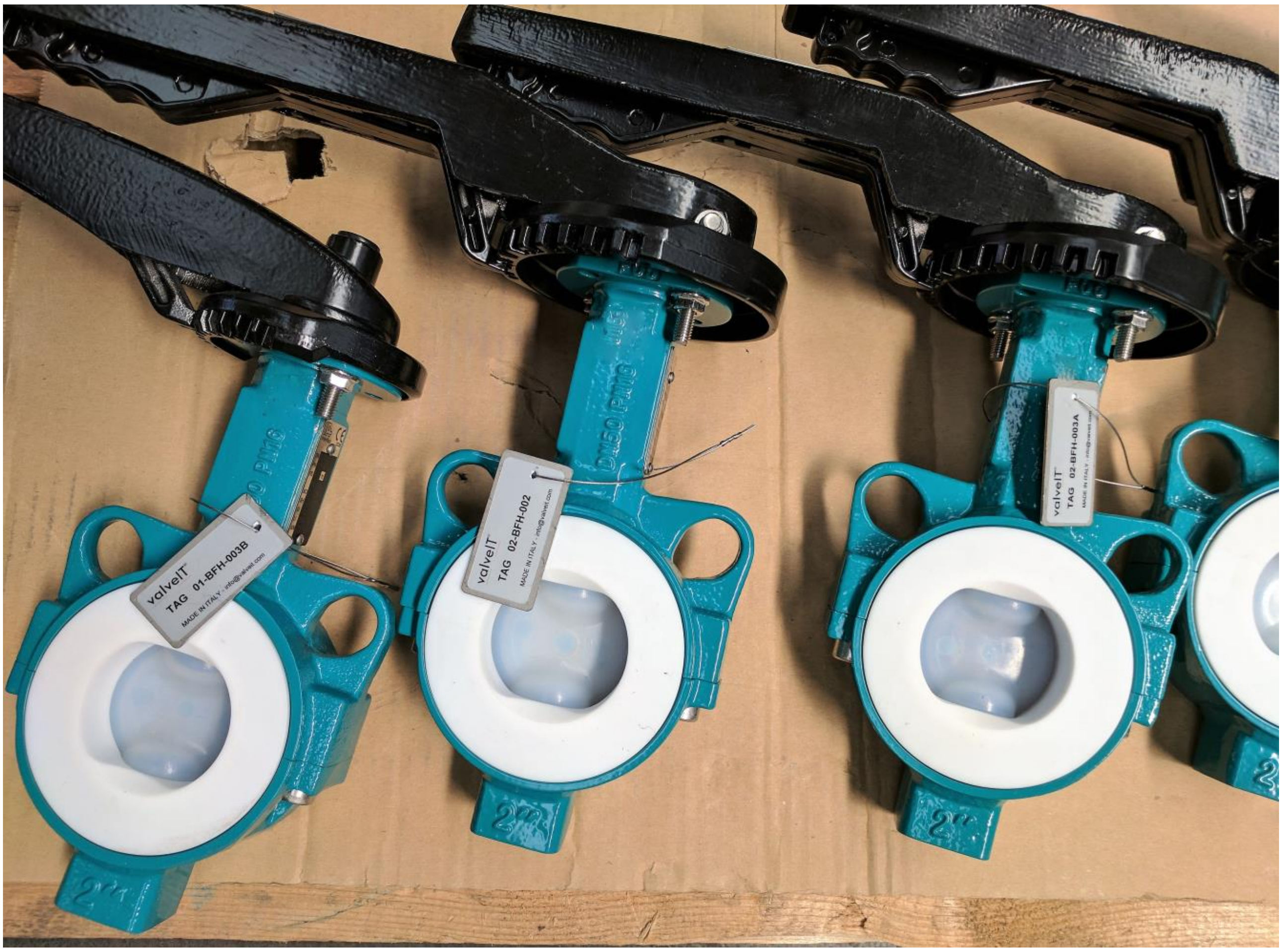

Figure 1.3 ValveIT Butterfly Valve DN40 PN10 - Wafer Body: Ductile Iron Disc: PFA coated PTFE with Hand Level

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PTFE
Material Properties

Polytetrafluoroethylene or PTFE is the commonly used versatile, high-performance fluoropolymer made up for carbon and fluorine atoms.

PTFE is used as a cost-effective solution for industries ranging from oil & gas, chemical processing, industrial to electrical/electronic and construction sector, etc.

The basic properties of PTFE which make it an interesting material with high commercial value are:

- Exception chemical resistance
- Good resistance to heat and low temperature
- Good electrical insulating power in hot and wet environments
- Good resistance to light, UV and weathering
- Low coefficient of friction
- Low dielectric constant/dissipation factor
- Strong anti-adhesion properties
- Flexibility
- Good fatigue resistance under low stress
- Availability of food, medical and high-purity grades
- Low water absorption

PTFE is a linear polymer of tetrafluoroethylene (TFE). It is manufactured by free-radical polymerization mechanism in an aqueous media via addition polymerization of TFE in a batch process.

The chemical structure of PTFE [CF2-CF2]n is like that of polyethylene (PE), except that the hydrogen atoms are completely replaced by fluorine (hence it is referred as perfluoro polymer). However, it is important to note that in practice PTFE and PE are prepared and used in totally different ways.
It is the size of fluorine atom which forms a uniform and continuous sheath around carbon-carbon-bonds and hence imparts good chemical resistance and stability to the molecule. This uniform fluorine sheath also provides electrical inertness to the molecule.

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The fluorine content in PTFE is theoretically 76% and it has 95% crystallinity.

PTFE was first discovered "accidentally" in 1938 by Dr. Plunkett at DuPont. After that PTFE was made commercially available in 1947 with the trademark "Teflon™" from Chemours. It was the discovery of PTFE that accelerated the development of the other fluoropolymers.

PTFE is available in granular, fine powder and water-based dispersion forms.

- The **granular PTFE resin** is produced by suspension polymerization in an aqueous medium with little or no dispersing agent. Granular PTFE resins are mainly used for molding (compression and isostatic) and ram extrusion.

- The **fine PTFE powder** is prepared by controlled emulsion polymerization, and the products are white, small sized particles. Fine PTFE powders can be processed into thin sections by paste extrusion or used as additives to increase wear resistance or frictional property of other materials.

- **PTFE dispersions** are prepared by the aqueous polymerization using more dispersing agent with agitation. Dispersions are used for coatings and film casting.

As discussed above, PTFE has excellent properties such as chemical inertness, heat resistance (both high and low), electrical insulation properties, low coefficient of friction (static 0.08 and dynamic 0.01), and nonstick property over a wide temperature range (260 to 260°C).

- It has a **density** in the range of 2.1 - 2.3 g/cm^3 and melt viscosity in the range of 1 -10 GPa per second

- **PTFE is among the most chemically resistant polymer**. The exceptions include molten alkali metals, gaseous fluorine at high temperatures and pressures, and few organic halogenated compounds such as chlorine trifluoride (ClF_3) and oxygen difluoride (OF_2).

- **Mechanical properties of PTFE** are generally inferior to engineering plastics at the room temperature. Compounding with fillers has been the strategy to overcome this shortage. PTFE has useful mechanical properties in its use temperature range.
  The mechanical properties of PTFE are also affected by processing variables such a preform pressure, sintering temperature, cooling rate etc. Polymer variable such as molar mass, particle size, particle size distribution poses significant impact on mechanical properties.

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- **PTFE has excellent electrical properties** such as high insulation resistance, low **dielectric constant**. has an extremely low dielectric constant (2.0) due to the highly symmetric structure of the macromolecules.

- PTFE exhibits high thermal stability without obvious degradation below 440 °C

- PTFE materials can be **continuously used below 260°C**.

- PTFE is attacked by radiation, and degradation in air begins at a dose of 0.02 Mrad.

These properties come from the special electronic structure of the fluorine atom, the stable carbon-fluorine covalent bonding, and the unique intramolecular and intermolecular interactions between the fluorinated polymer segments and the main chains.

Property	Value
Melting Temperature (°C)	317-337
Tensile Modulus (MPa)	550
Elongation at Break (%)	300-550
Dielectric strength (kV/mm)	19.7
Dielectric Constant	2.0
Dynamic Co-efficient of Friction	0.04
Surface Energy (Dynes/g)	18
Appl. Temperature (°C)	260
Refractive Index	1.35

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