Meeting tough new requirements on elastomers in oilfield applications

Recovering crude oil from the depths of the earth is becoming more challenging: environmental standards, sustainability issues, and difficult-to-reach oilfields are making drilling more technically demanding.

In oil & gas exploration and production, elastomers perform a host of critical functions topside and downhole, where demands on the polymeric materials are continually increasing. They must, for example, allow for increasing temperatures, higher pressures and resist more severe chemical environments, while also ensuring the quality, efficiency and longevity of vital production components.

The selection of elastomers and correct formulation has, therefore, become more demanding in recent years: presenting increasingly complex issues. This is evidenced by a trend towards project-specific developments and closer collaboration between materials suppliers and oil & gas companies.

Materials have to be closely adapted to the different drilling locations and its specific conditions. Careful choice of elastomer and correct compound design are essential to ensuring that components add long-term value to processes for recovering these costly energy resources.

High resistance

All elastomers used in the oilfield industry must provide high resistance to oils, drilling muds and various aggressive production fluids.

Compounds also need to exhibit a range of outstanding properties, including high tensile strength, excellent dynamic properties, good abrasion resistance, high heat & chemical resistance, and operate over a wide temperature range.

Possible applications range from Arctic temperatures down to minus 60°C up to temperatures of over 250°C.

In addition to their ability to withstand extremes of cold and heat, materials are often also subjected to extremely high-pressure loads. In some high-pressure, high-temperature (HPHT) applications, pressures of over 260 MPa can be seen. To combine heat resistance with high strength and good chemical resistance is a real challenge.

Elastomer compounds have to be strong enough to take the impact during handling, installation and operation. If a sealing lip wears away or has been damaged by rapid gas decompression (RGD), potential for leakage arises.

Moreover, if the elastomer part of a stator (elastomer lobes) gradually wears away, pumping efficiency can drop. Or if the heat build-up in the rubber lobes increases too much, due to internal friction, then severe premature failure of the stator can occur.

Furthermore, if elastomers are not sufficiently heat- and chemical-resistant then hardening, embrittlement, and severe set can take place, leading to failure of often critical parts, such as seals.

In oilfield service, elastomeric materials play major roles in protecting workers, equipment, and the environment, and replacing...
Collaboration proves key to oil-drilling project

In one specific project for the oilfield industry, Zeon was heavily involved in the compound development for elastomer packers. The challenge was to achieve an elastomer compound with very high hardness (around 90 Shore A) that had good elongation and high tear strength at elevated application temperatures. In addition, good compression set resistance was required for improved long-term sealing properties and to allow for the easy retrieval of the packer from downhole after service. The balance of achieving all of these properties is very difficult due to the fact that when one property is optimised other properties can fall out of specification.

Finally, the manufacturing and processing properties of the elastomer compound had to be optimised. The final compound met all the requirements using a blend of polymers and fillers in conjunction with an effective and appropriate cure system.

With close cooperation and with a good, open relationship with the end customer and the manufacturer a compound was developed, tested, successfully processed and is now in use downhole.

Full details of the project cannot be disclosed due to confidentiality, but this is an example of engagement between materials supplier and customer and supply-chain assisting where possible, through every aspect of the project, from polymer selection, compound development and testing, right through to final manufacturing optimisation.