ORD Problem Solved!

Ozone Attack

Ozone cracking is caused by an aggressive chemical attack on a double bonded seal polymer. Elastomers with double bonds in their molecular chains are highly susceptible to ozone attack. In their free state, the polymer remains unstressed, therefore the molecular interference prevents ozone from attacking the double-bonds. However, when the polymer chains are stretched, the molecular interference is disrupted, thereby exposing the double-bonds. Once this double-bond is exposed, it reacts with ozone and breaks at this point. This is then repeated for each progressively deeper layer of polymer chains within the rubber. On the surface, this shows up as cracking in the seal. This ozone cracking permits gases and fluids to pass through in an application.

For leak troubleshooting assistance, contact O-Ring Division's Applications Engineering Department at 859-335-5101or try our Leak Troubleshooting Mobil App at http://divapps.parker.com/divapps/seal/mobile/mobilefailureanalysis/

Success Story

Application:
A nitrile (NBR) O-ring on a tube fitting for use in compressed natural gas (-50° to 275°F).

Problem:
A fitting manufacturer was assembling nitrile rubber (NBR) O-rings onto a standard SAE J1926/1 tube fitting. The fitting was to be used in a compressed natural gas (CNG) application. The customer was having issues with the O-rings after they had been installed on the fittings and placed into stock. The tube fittings were stocked on shelves for 2-4 weeks in a warehouse setting. When the fittings were pulled from the shelf, the O-rings had formed noticeable cracks around their circumference. These radial cracks were unacceptable for this CNG application because the gas would easily flow through the surface cracks of the O-ring forming a leak. The customer asked Parker to remedy their application problem; requesting the replacement material be low temperature capable and provide good resistance to the hydrocarbons present in CNG applications.

Parker's Solution:
The cracks that were forming on the surface of the NBR O-rings, when stretched over the tube fitting, are characteristic of a failure mode referred to as ozone attack. Ozone attack occurs when a NBR O-ring is stretched and exposed to ozone for a period of time, sometimes as short as a couple weeks. The ozone that is present in the earth's atmosphere is enough to break the polymer chains that make up the NBR compound, thereby forming surface cracks on the seal.

To prevent ozone attack, Parker proposed that the customer move to a compound that would provide ozone resistance while giving equivalent or better performance in CNG. Parker's KA183-85, a hydrogenated nitrile rubber (HNBR) compound, was recommended because of its ability to meet the low temperature requirement of the application. KA183-85 also provides excellent resistance to CNG and is ozone resistant.

Outcome:
The customer decided to change materials over to the HNBR compound KA183-85. This material change eliminated the customer's ozone attack issues while providing them with an 85 durometer, Shore A hardness, material that was good for use in applications with a temperature range of -55°F to 320°F. The customer was very satisfied with the performance of the KA183-85 compound and reported no more instances of ozone attack.