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## OZONE-RESISTANCE

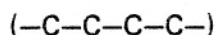
Ozone is a gas with a pungent characteristic odor. It is similar to an oxygen molecule (O<sub>2</sub>) in chemical structure but contains one more atom of oxygen (O<sub>3</sub>). Ozone can be produced anywhere a combination of air and an electrical discharge are present. It is usually encountered in dilute form mixed with air.

Ozone and cable coverings share a long interesting history. The chemical nature of ozone is such that it is capable of deteriorating virtually every extruded type of cable covering used in the industry. For many years the most practical method for obtaining some degree of ozone-resistance in a cable insulation was to incorporate a substantial quantity of polymerized oil or factice into the compound. The old familiar "oil-base" insulations are good examples of this technique. The disadvantage of obtaining ozone-resistance in this fashion is a significant sacrifice of heat aging resistance, low temperature flexibility and physical strength.

Cable problems related to ozone are most likely to occur at voltages about 5Kv. Six-hundred volt cables can also be attacked if they are in an environment where ozone is being generated.

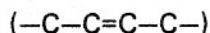
The mechanism involved when ozone deteriorates a cable covering is really a classical chemical reaction. Ozone is a powerful oxidant and whenever present it is ready for action — that's why it is used commercially as a germicide, in the purification of water, and for treatment of industrial wastes. Ozone attack of cable covering is more easily understood if the basic polymer used in making up the various coverings is considered as a discrete and identifiable chemical. The major component in polymers is a chain of carbon atoms. How these carbon atoms are linked or bonded together is the determining factor in predicting ozone-resistance.

In some polymers like Polyethylene and the Ethylene-Propylene types, the carbon-to-carbon link or bond in the main chain looks something like the following:



This arrangement provides excellent ozone-resistance.

Many polymers like SB-R and natural rubber have a carbon-to-carbon linkage or bond that looks like this:



Notice there is a double bond between two of the carbons. This is the location where ozone attacks and reacts, splitting the carbon chain. This shows up as radial cracks in a cable covering. The more of these double bonds present, the more quickly the deterioration in the presence of ozone. Polymers of this type are limited to 600-volt service.

Butyl rubber is the granddaddy of medium-voltage insulations with inherent or built-in-ozone-resistance. Butyl rubber contains a limited number of double bonds. These are virtually used up in the vulcanizing process. The resulting compound has a high degree of ozone-resistance without sacrificing important properties as was the case with oil-base compounds.

The Insulated Products Engineering Center is constantly on the alert for new polymers with attractive properties. One of these properties is inherent or built-in-ozone-resistance. Hypalon, Butyl and the EP rubbers are good examples – they have this plus feature that contributes to cable reliability.

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