Effects of THERMAX in Elastomers

Static Properties of Thermal Black in Elastomers

Thermal carbon black is used extensively in the rubber industry due to its low interaction with host compounds. The low surface area combined with low structure allow thermal black to move more easily in an elastomer, minimizing reinforcement and thereby extending the compound without appreciably modifying its physical properties. The more common physical properties of thermal black are as follows:

Modulus

Modulus is an expression of the force per cross-sectional unit area required to stretch a test piece to a given elongation. It may also be considered as resistance to elongation or stiffness in the vulcanizate.

Tensile Strength

Tensile strength is defined as the force per cross-sectional unit area applied at the rupture point of the specimen. It is calculated by dividing the applied force at rupture divided by the initial cross-sectional area of the specimen.

Elongation

Elongation is used to describe the ability of rubber to stretch without breaking. It is more accurate to describe this ability as ultimate elongation; elongation just before the point of rupture. Its value is taken as a percentage of its original length.

Hardness

Hardness in rubber is defined as the ability to resist indentation. It is expressed as a number referring to the scale on the instrument used for the measurement. All the hardness measurements in this section are on the Shore A scale commonly used for soft rubbers.

Tear Resistance

Tear resistance in rubber may be described as the resistance to growth of a nick or cut when tension is applied. It is expressed in force per unit length.

Compression Set

Compression set is the percentage by which a standard specimen fails to return to its original thickness, after being subjected to a standard compressive load or deflection for a fixed period of time.

Low Air Permeability

Thermal black has the widest particle size range distribution (80-550 nm) of any carbon black. This, coupled with the fact that the particles are essentially spheres, allows it to minimize void spaces at high loadings. In effect, thermal black at high loading creates longer, more tortuous diffusion paths for gas molecules. This makes thermal black ideal for applications such as hoses or inner tubes.

Chemical and Heat Resistance

The stable and inactive surface of thermal black and its relatively low surface area prevents or reduces its chemical interaction with oils, fuels, fuel additives and oil drilling chemicals. Thermal black also has excellent heat resistance. Many high performance elastomer compounds can incorporate thermal black without degradation of their properties; the resulting compound withstands harsher environments.

Electrical Insulation

Thermal black has excellent dielectric properties and, when used as a filler, allows various elastomers to retain their high volume resistivity. Its large particle size and low structure are not conducive to the mechanism of semi-conductivity, namely electron tunneling. Styrene butadiene rubber insulating materials use thermal black, as do neoprene automotive wire compounds and plugs. One of the largest uses of thermal black is in cross-linked polyethylene power cables; thermal black not only helps to extend the compound, maintain dielectric properties and reduce the nerve of the polymer, but also provides ultra-violet radiation protection and flame retardancy.

Highly Extended Compounds

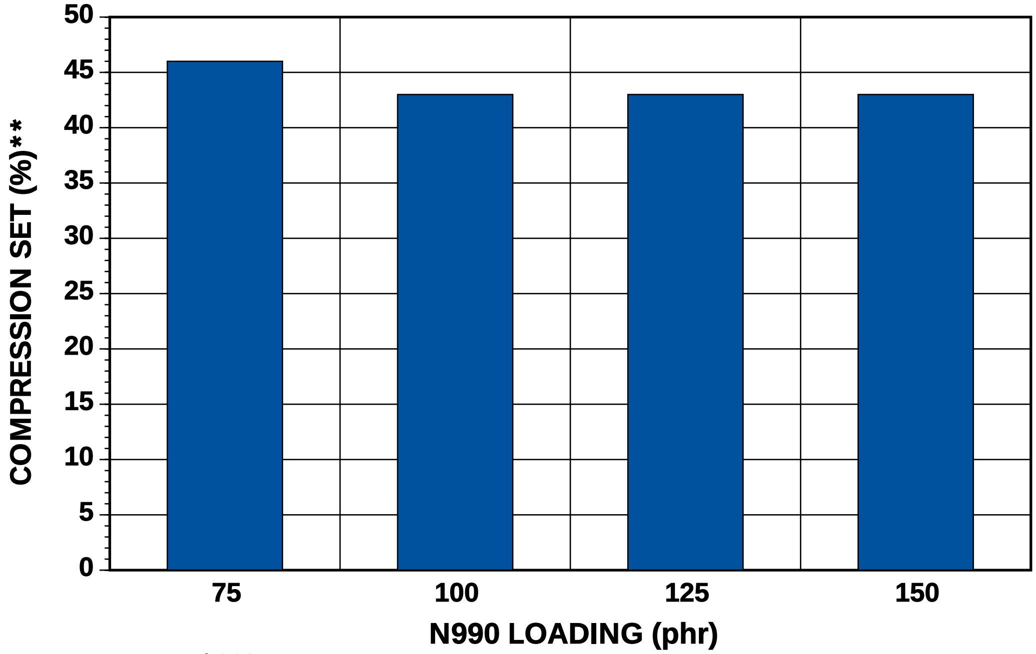
Since thermal black does not seriously degrade inherent rubber properties, it can often be compounded at very high loading levels. In the following charts, the various physical properties illustrated show the least amount of change in properties versus loading of thermal black. This practice of high loading can also reduce overall compound costs. Neoprene mechanical rubber goods quite often contain 100-200 parts per hundred of thermal black.

In many rubber applications, thermal black is combined with a more reinforcing carbon black such as N330, N550, N660 or N762. By adding a thermal black, the dynamic properties of an already reinforced rubber compound can be enhanced. To a limited extent thermal black is used as a colorant in rubber and plastics. Its low surface area provides a blue-gray tone to such plastics as polyvinyl chloride, ABS, polypropylene and silicone.

The following charts illustrate the effects of thermal carbon black N990 on several physical properties of butyl rubber (Figure 1a-1g), EPDM (Figure 2a-2k), natural rubber (Figure 3a-3g), chloroprene rubber (Figure 4a-4g), nitrile rubber (Figure 5a-5l), polyacrylate rubber (Figure 6a-6h) and styrene butadiene rubber (Figure 7a-7g).

Figure 1a

Effects of N990 in Butyl Rubber* – compression set



* - Butyl 268

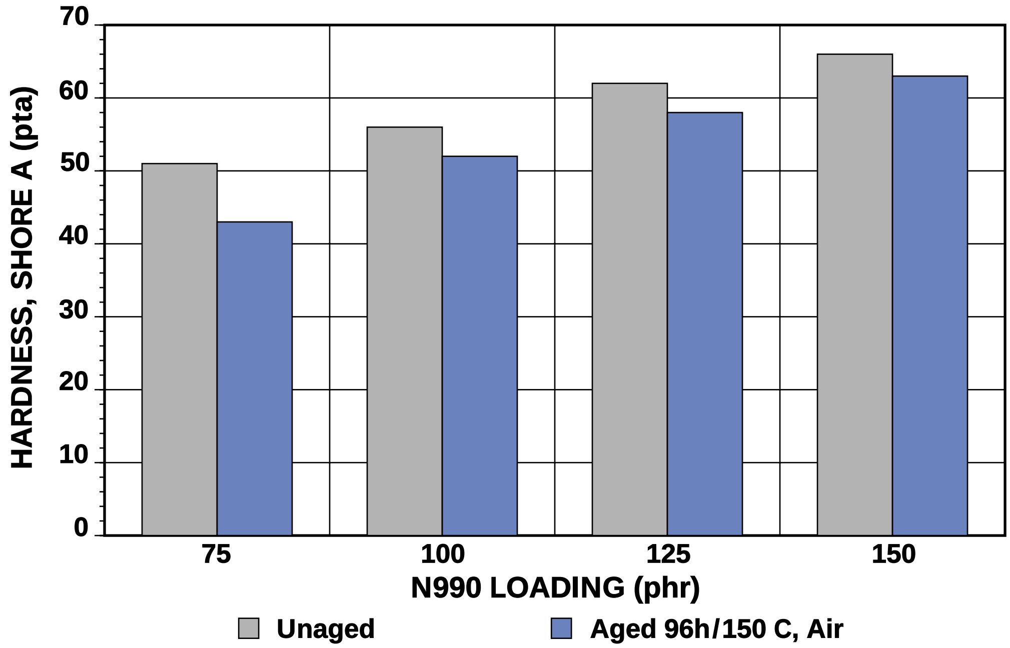
** - 70h @ 100 C

Source - R.T. Vanderbilt

Formula-See Appendix I

Figure 1b

Effects of N990 in Butyl Rubber* – hardness

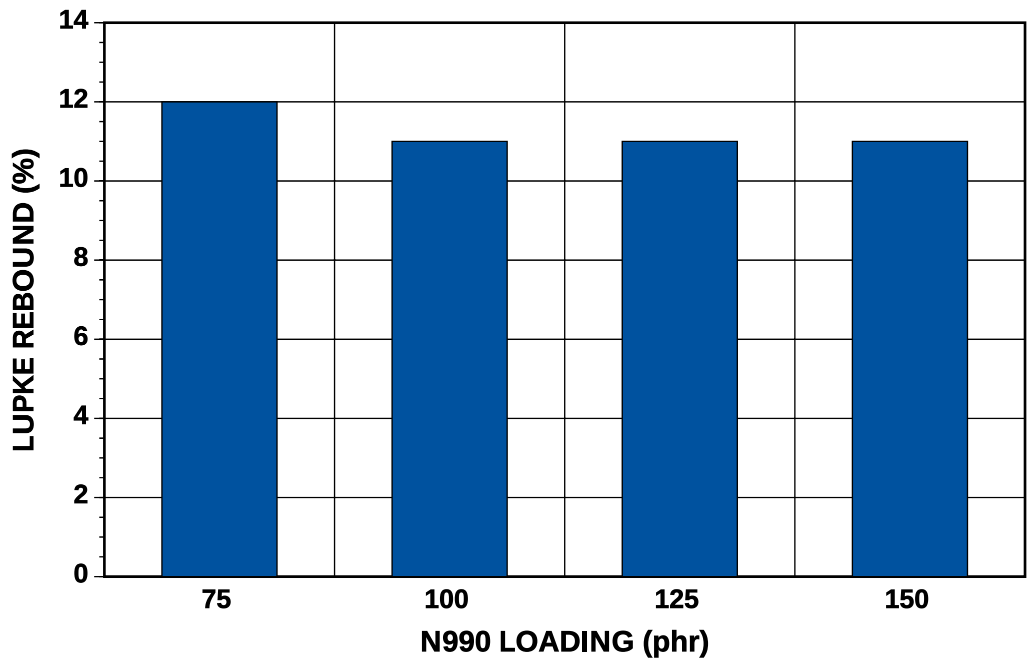


Source - R.T. Vanderbilt

Formula-See Appendix I

* - Butyl 268

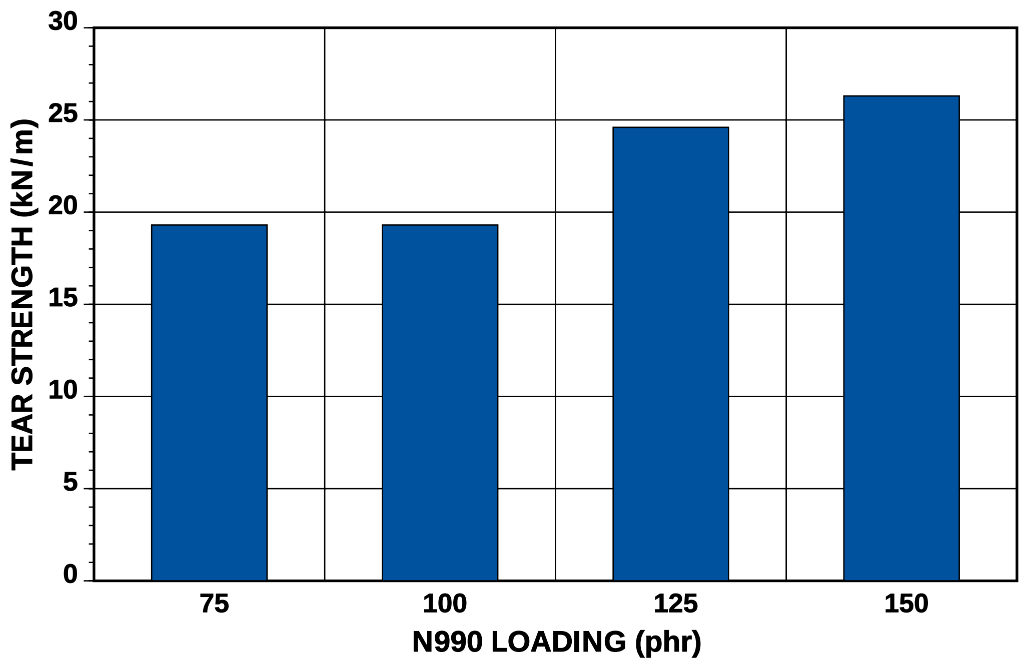
Figure 1c
Effects of N990 in Butyl Rubber* – resilience



Source - R.T. Vanderbilt
Formula-See Appendix I

* - Butyl 268

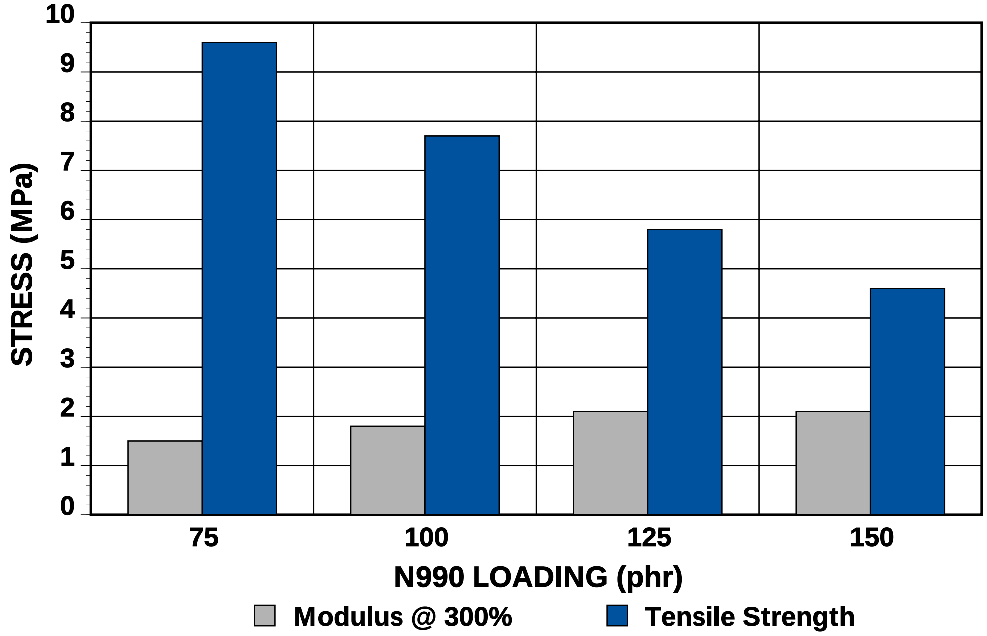
Figure 1d
Effects of N990 in Butyl Rubber* – tear strength



Source - R.T. Vanderbilt
Formula-See Appendix I

* - Butyl 268

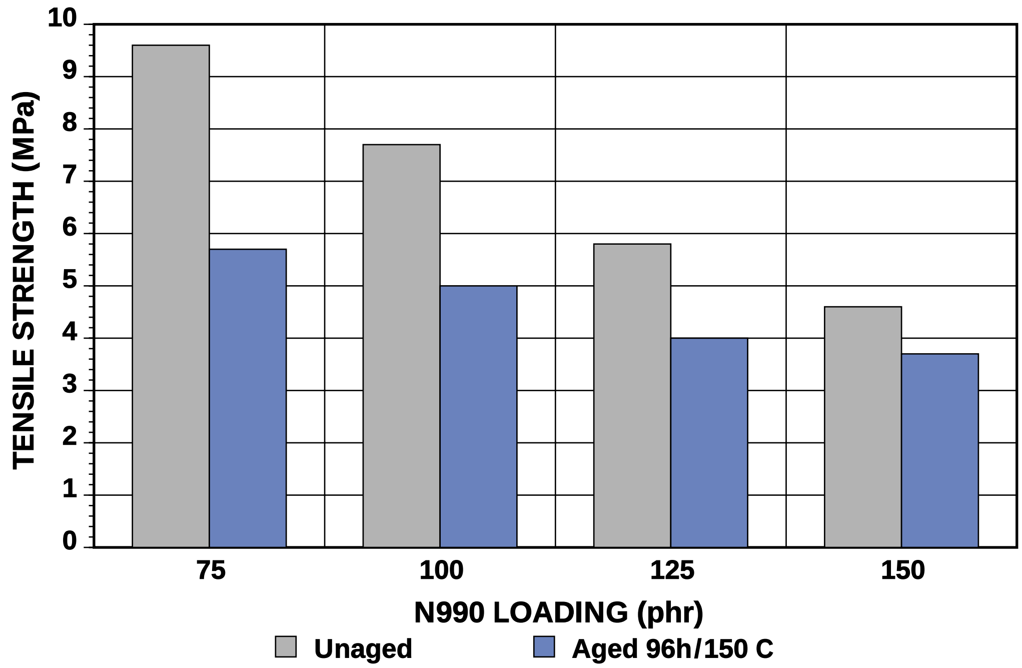
Figure 1e
Effects of N990 in Butyl Rubber* – tensile properties



* - Butyl 268

Source - R.T. Vanderbilt
Formula-See Appendix I

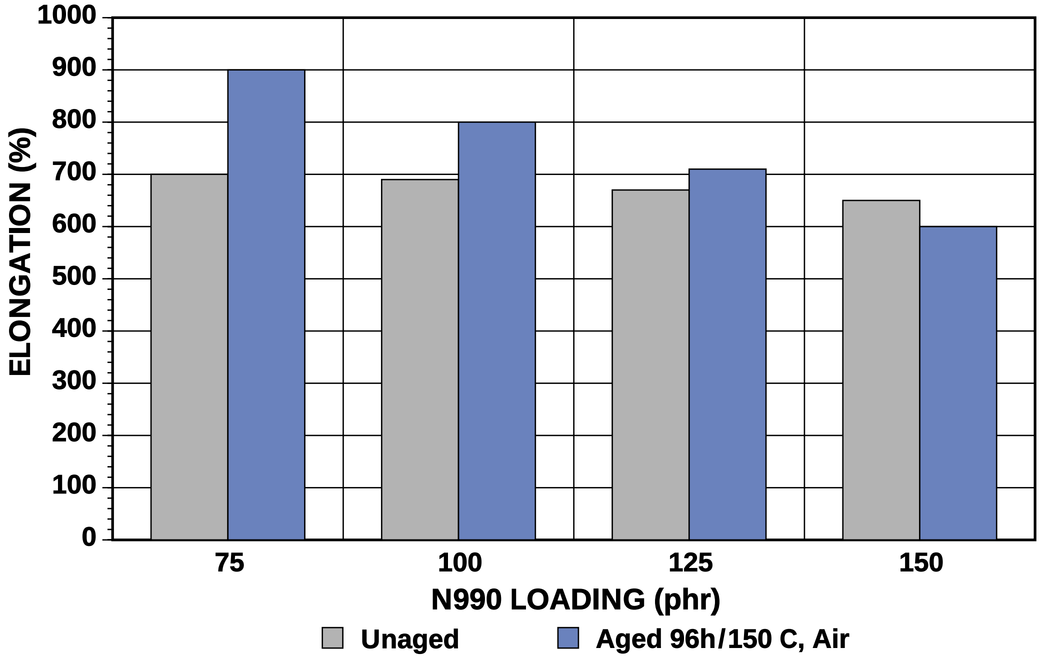
Figure 1f
Effects of N990 in Butyl Rubber* – tensile strength



* - Butyl 268

Source - R.T. Vanderbilt
Formula-See Appendix I

Figure 1g
Effects of N990 in Butyl Rubber* – ultimate elongation

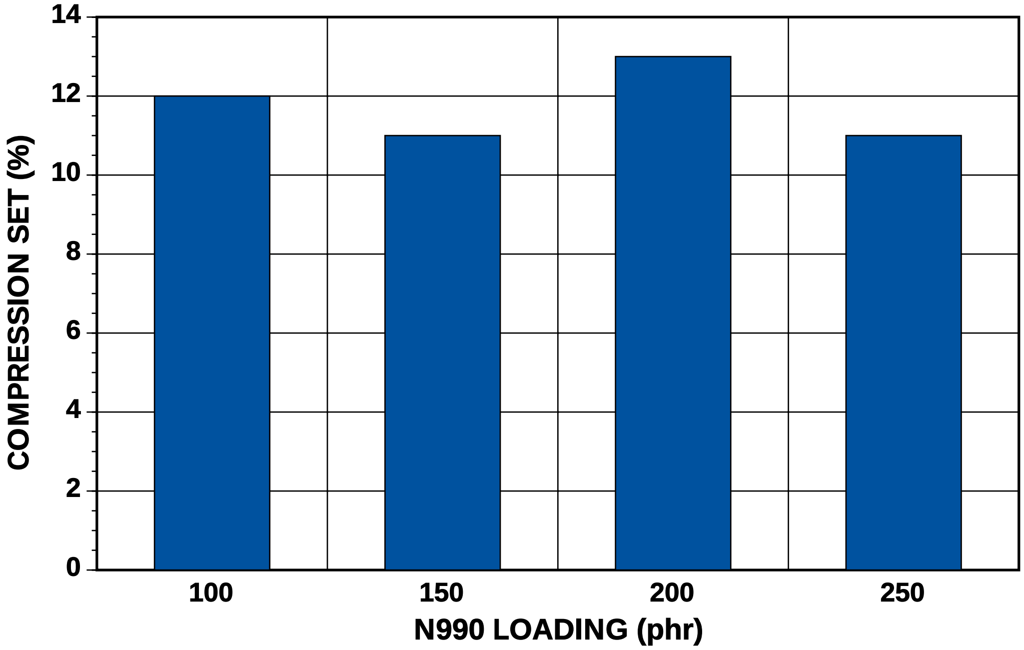


* - Butyl 268

Source - R.T. Vanderbilt
Formula-See Appendix I

Figure 2a

Effects of N990 in EPDM Rubber* – compression set

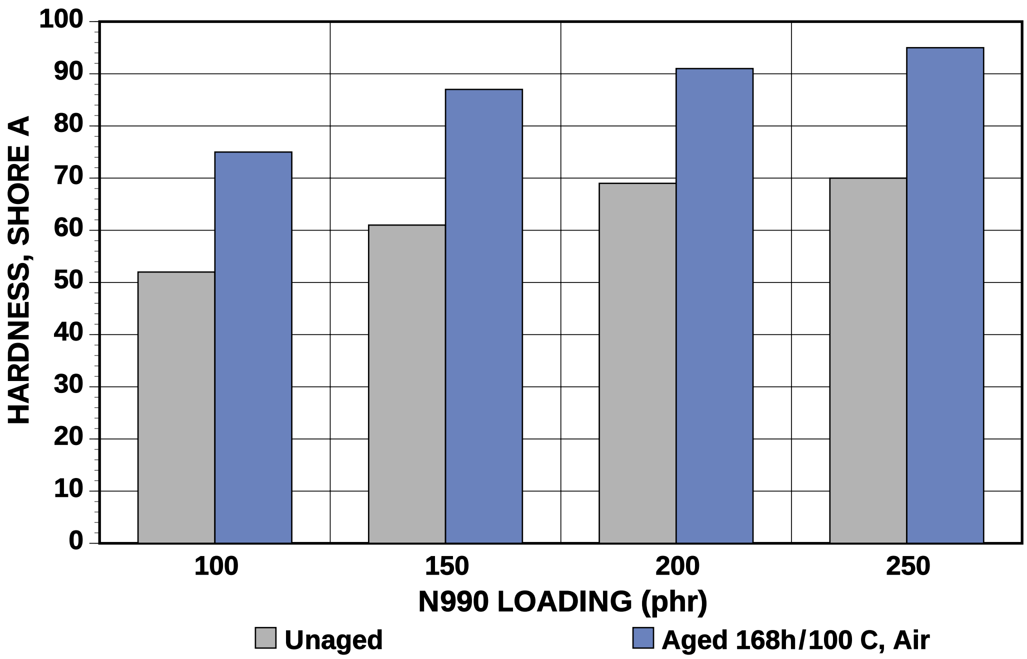


* - NORDEL 1070
After 22h @ 70 C

Source - Cancarb
Formula-See Appendix II

Figure 2b

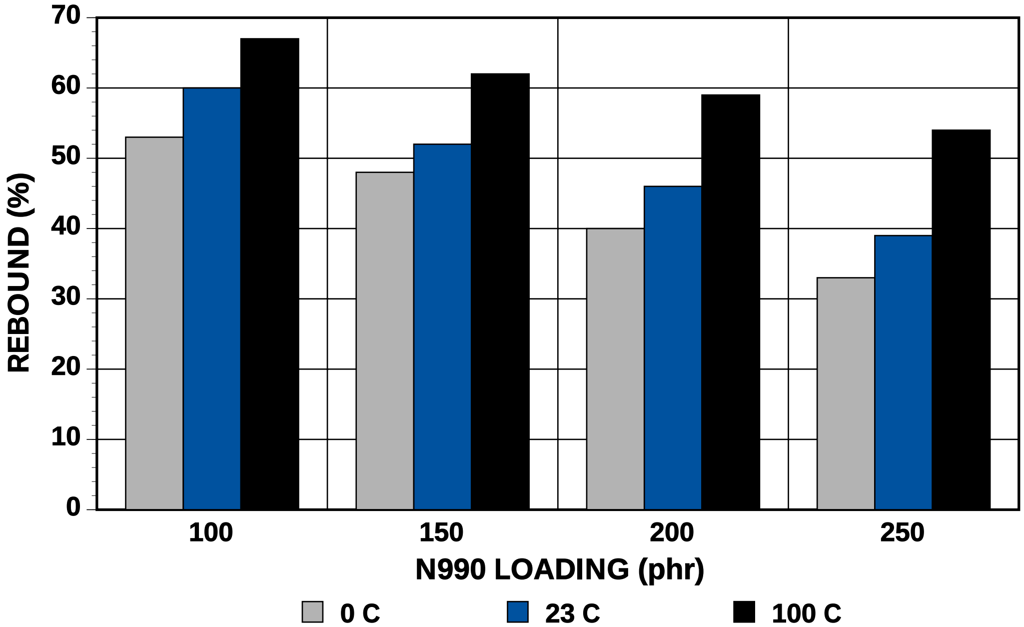
Effects of N990 in EPDM Rubber* – hardness



Source - Cancarb
Formula-See Appendix II

* - NORDEL 1070

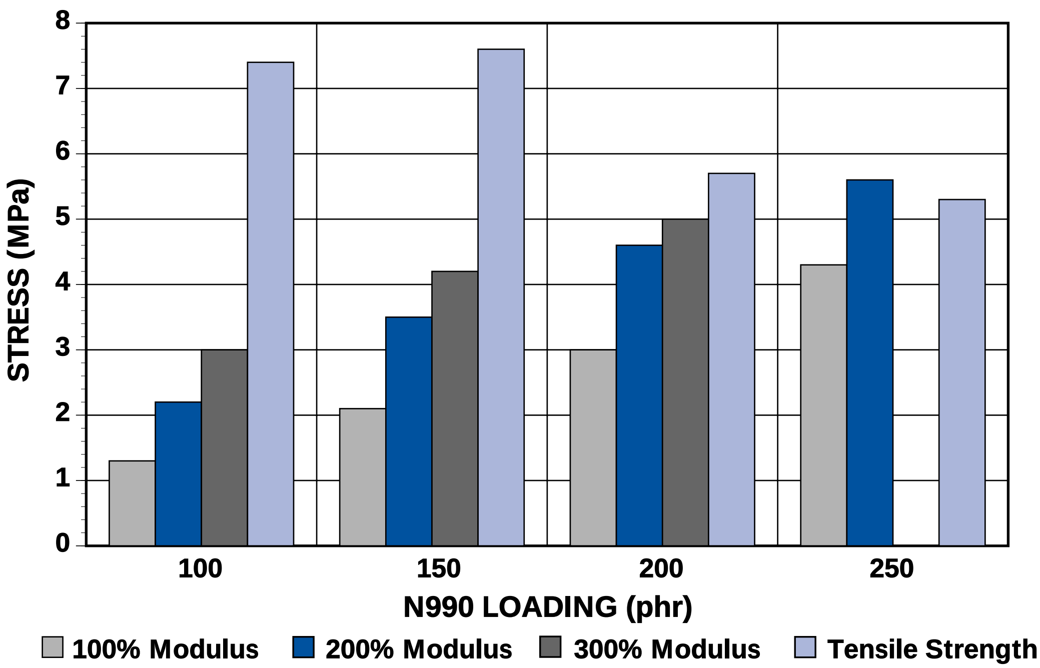
Figure 2c
Effects of N990 in EPDM Rubber* – resilience



* - NORDEL 1070

Source - Cancarb
Formula-See Appendix II

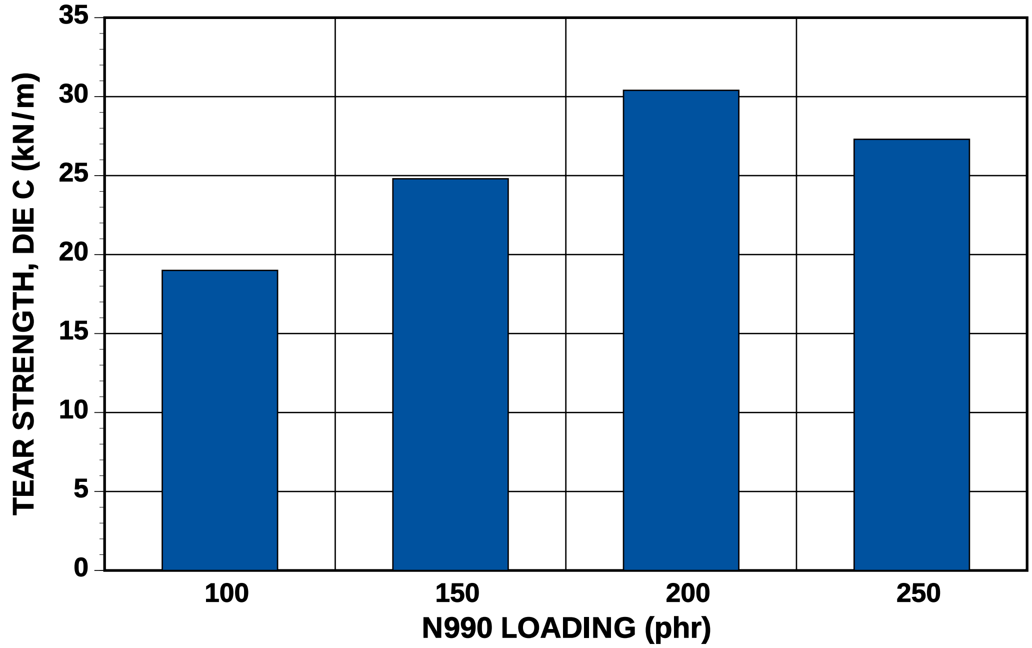
Figure 2d
Effects of N990 in EPDM Rubber* – tensile properties



* - NORDEL 1070

Source - Cancarb
Formula-See Appendix II

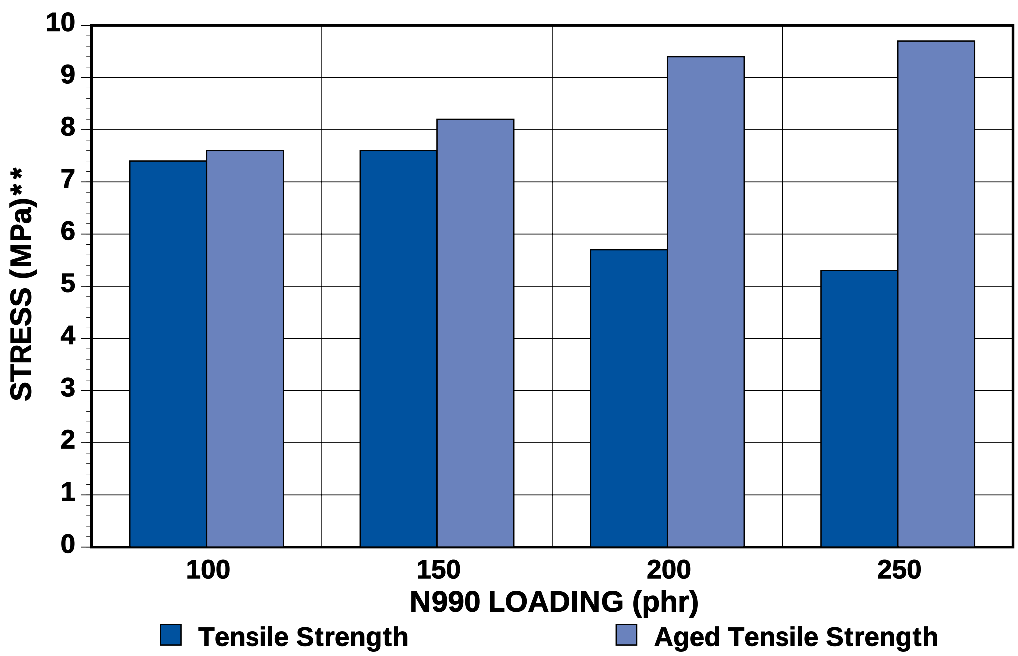
Figure 2e
Effects of N990 in EPDM Rubber* – tear strength



* - NORDEL 1070

Source - Cancarb
Formula-See Appendix II

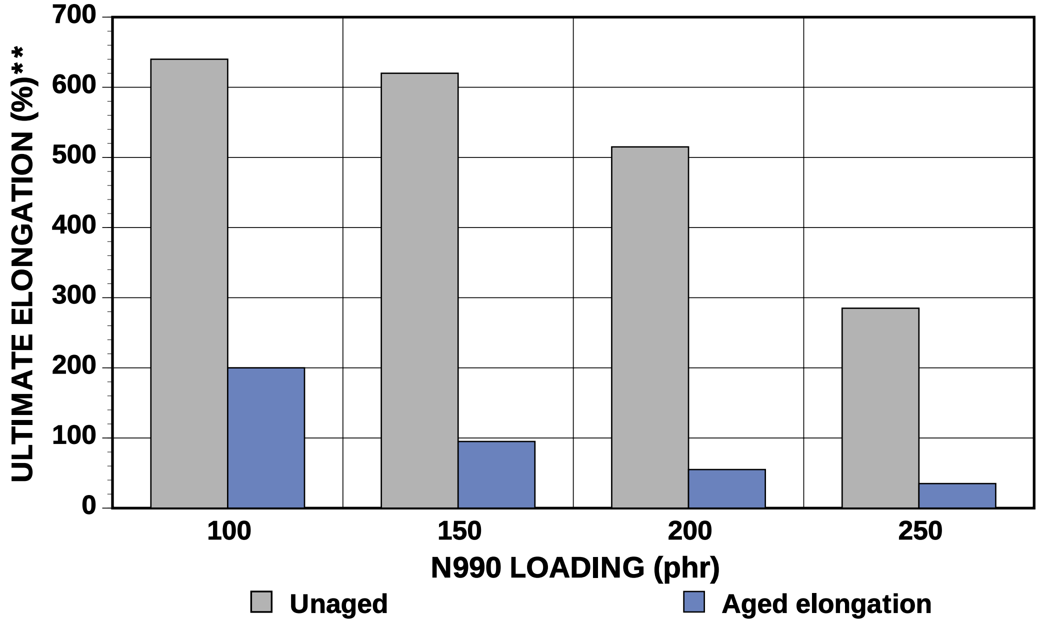
Figure 2f
Effects of N990 in EPDM Rubber* – tensile strength



* - NORDEL 1070
** - Aged in Air, 188h @ 150 C

Source - Cancarb
Formula-See Appendix II

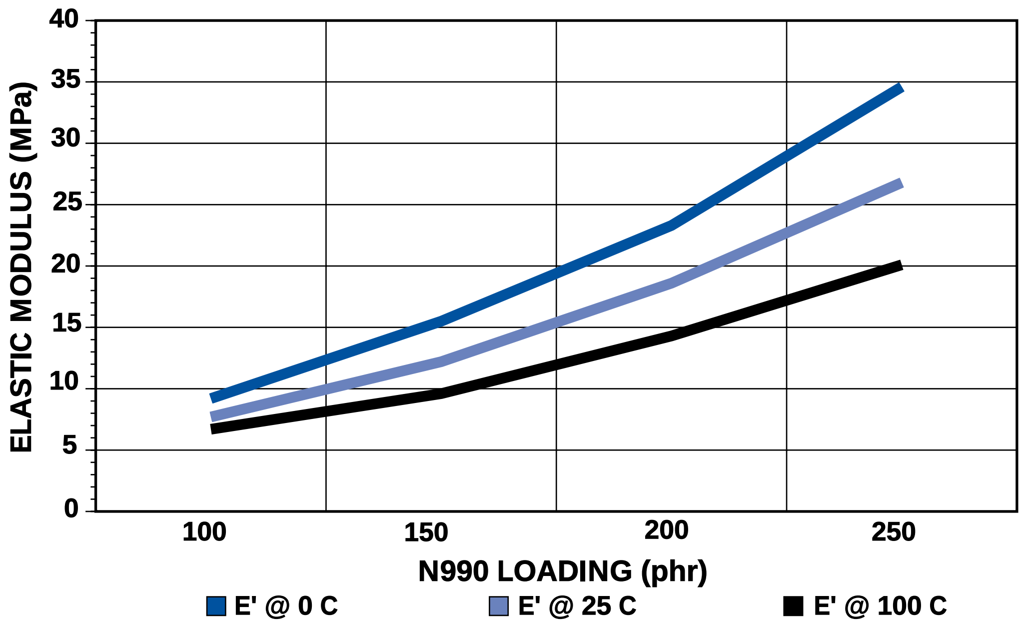
Figure 2g
Effects of N990 in EPDM Rubber* – ultimate elongation



* - NORDEL 1070
** - Aged in AIr, 188h @ 150 C

Source - Cancarb
Formula-See Appendix II

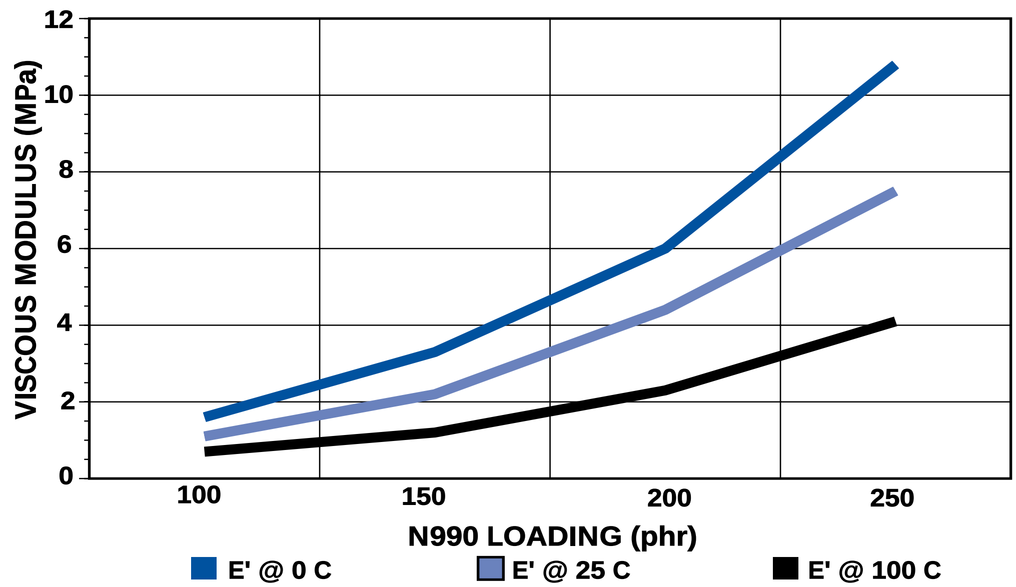
Figure 2h
Effects of N990 in EPDM Rubber* – elastic modulus



Source - Cancarb
Formula - See Appendix II

* - NORDEL 1070

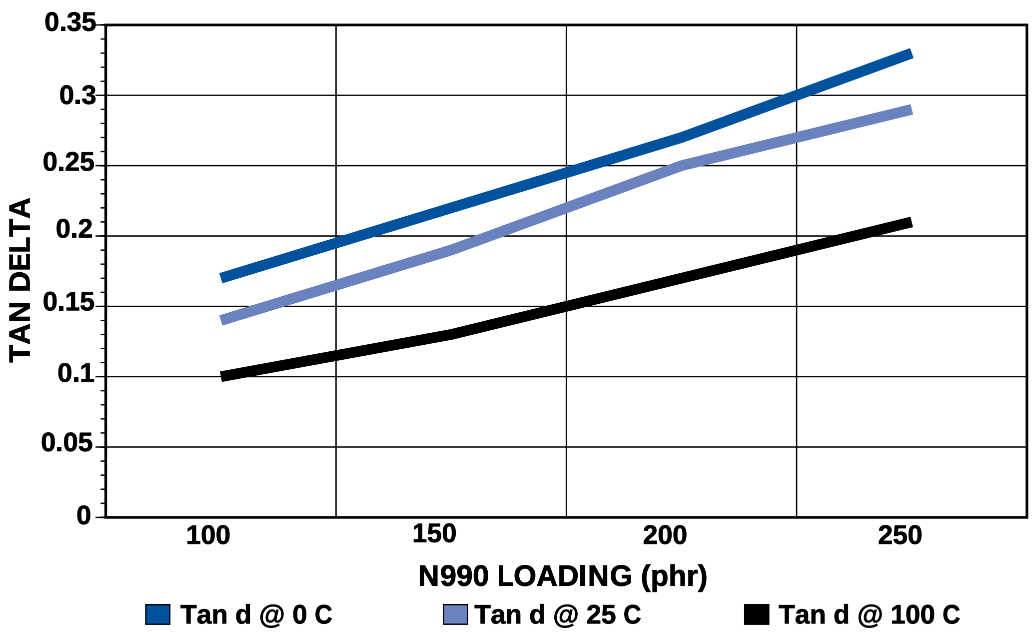
Figure 2i
Effects of N990 in EPDM Rubber* – viscous modulus



Source - Cancarb
Formula - See Appendix II

* - NORDEL 1070

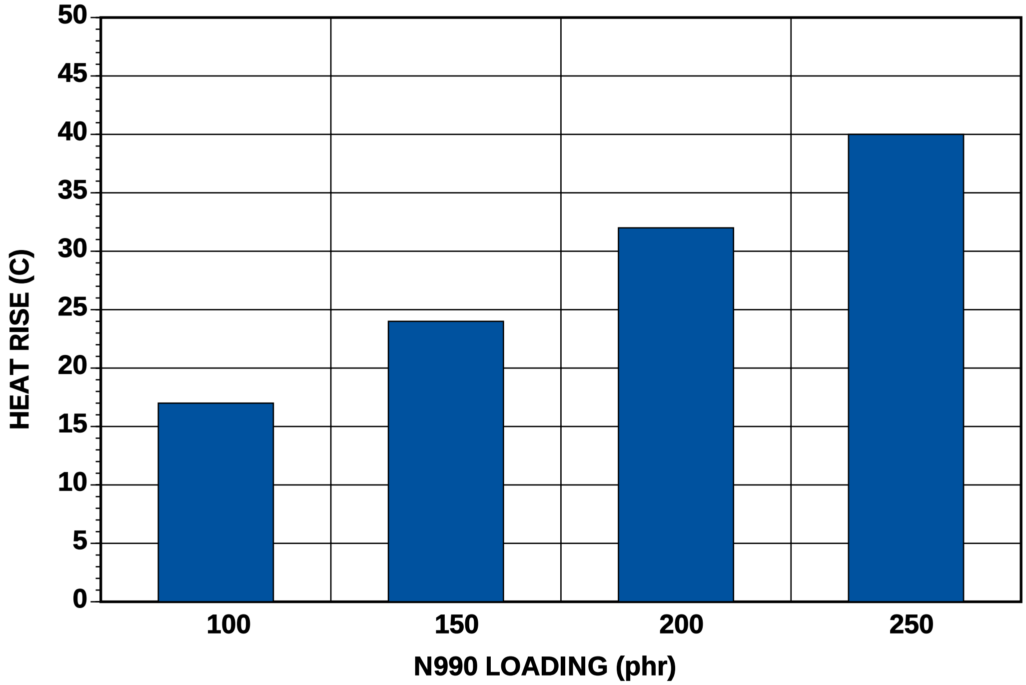
Figure 2j
Effects of N990 in EPDM Rubber* – tan delta



Source - Cancarb
Formula - See Appendix I

* - NORDEL 1070

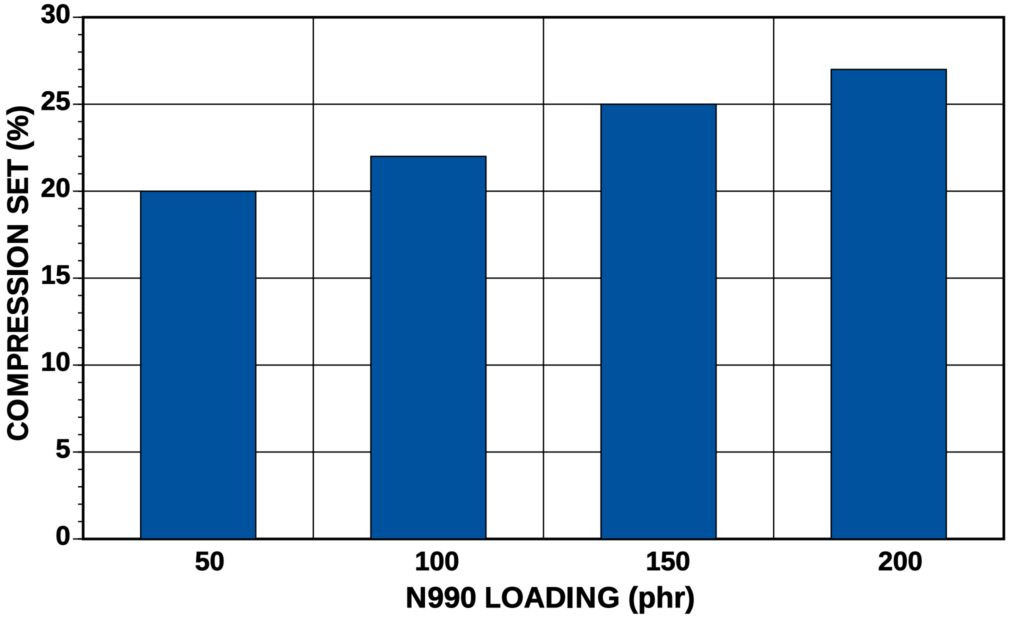
Figure 2k
Effects of N990 in EPDM Rubber* – FATIGUE



* - NORDEL 1070

Source - Cancarb
Formula - See Appendix II

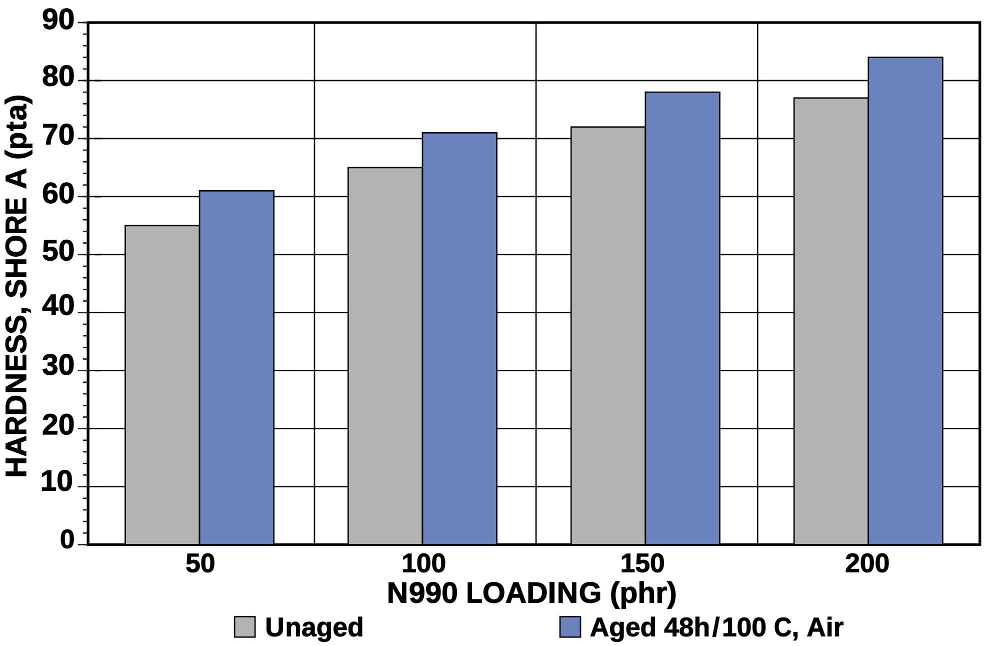
Figure 3a
Effects of N990 in Natural Rubber* – compression set



* - SMR-5

Source - R.T. V anderbilt
Formula-See Appendix I

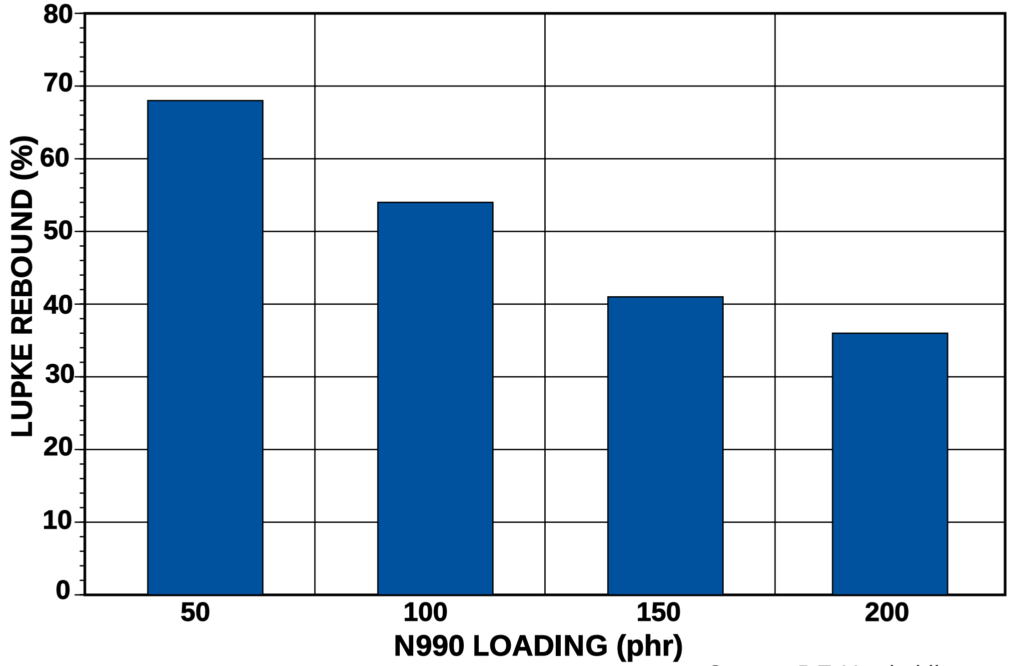
Figure 3b
Effects of N990 in Natural Rubber* – hardness



* - SMR-5

Source - R.T. Vanderbilt
Formula-See Appendix I

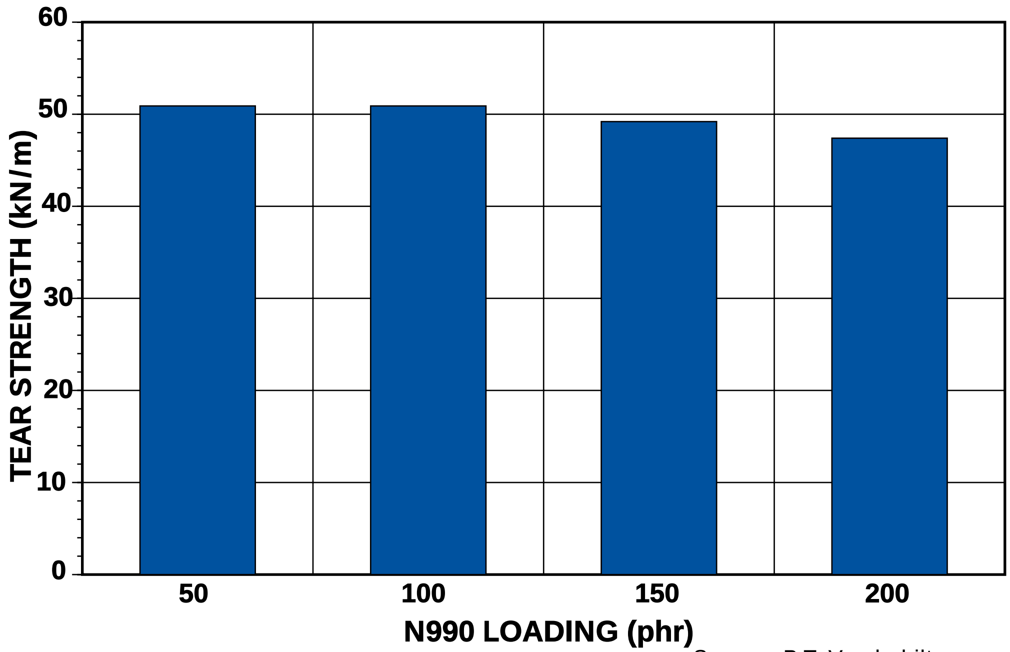
Figure 3c
Effects of N990 in Natural Rubber* – resilience



* - SMR-5

Source - R.T. Vanderbilt
Formula-See Appendix I

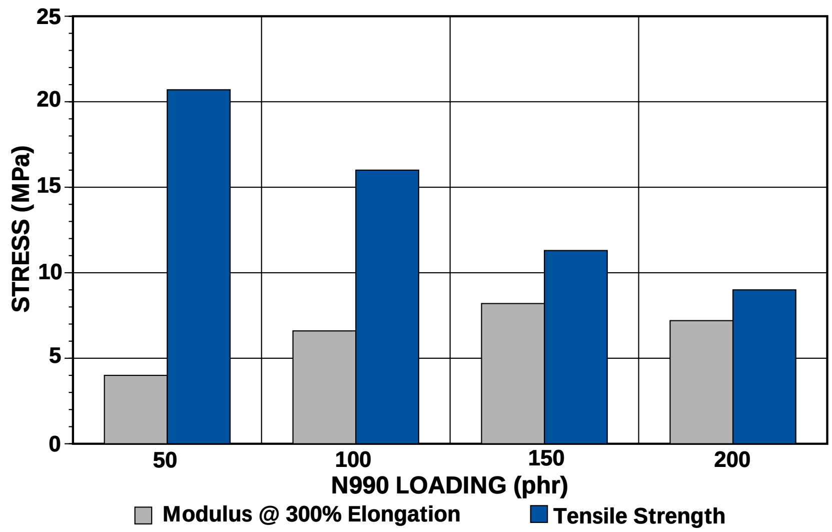
Figure 3d
Effects of N990 in Natural Rubber* – Tear strength



* - SMR-5

Source - R.T. Vanderbilt
Formula-See Appendix I

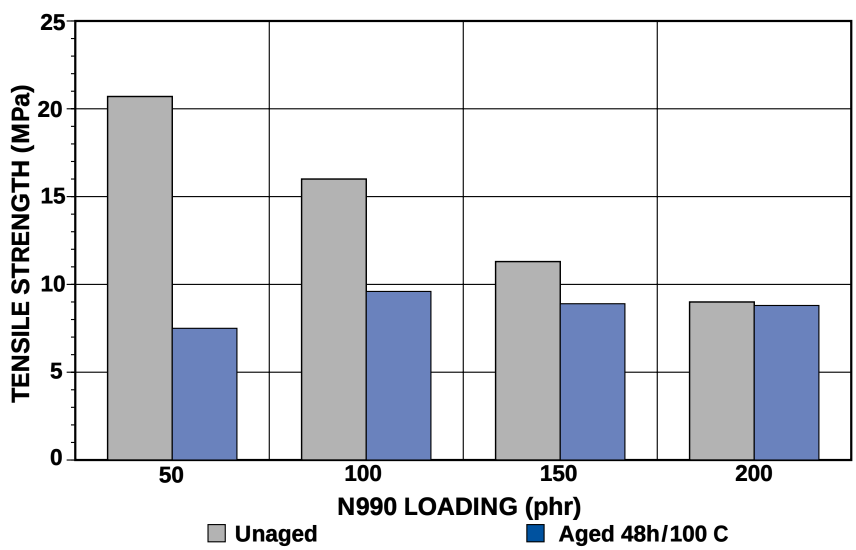
Figure 3e
Effects of N990 in Natural Rubber* – tensile properties



* - SMR-5

Source - R.T. Vanderbilt
Formula-See Appendix I

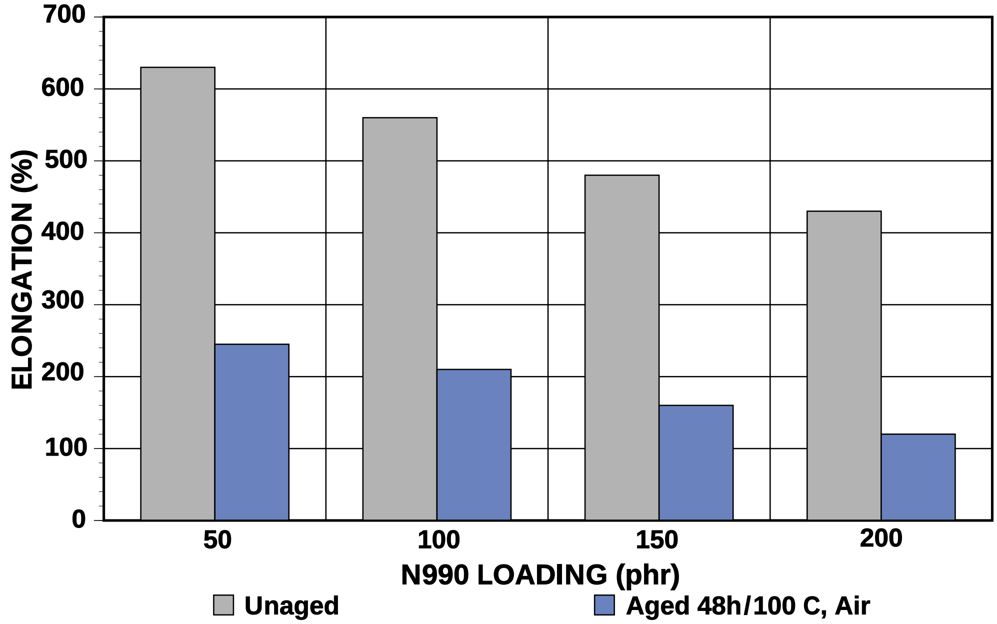
Figure 3f
Effects of N990 in Natural Rubber* – tensile strength



* - SMR-5

Source - R.T. Vanderbilt
Formula-See Appendix I

Figure 3g
Effects of N990 in Natural Rubber* – ultimate elongation

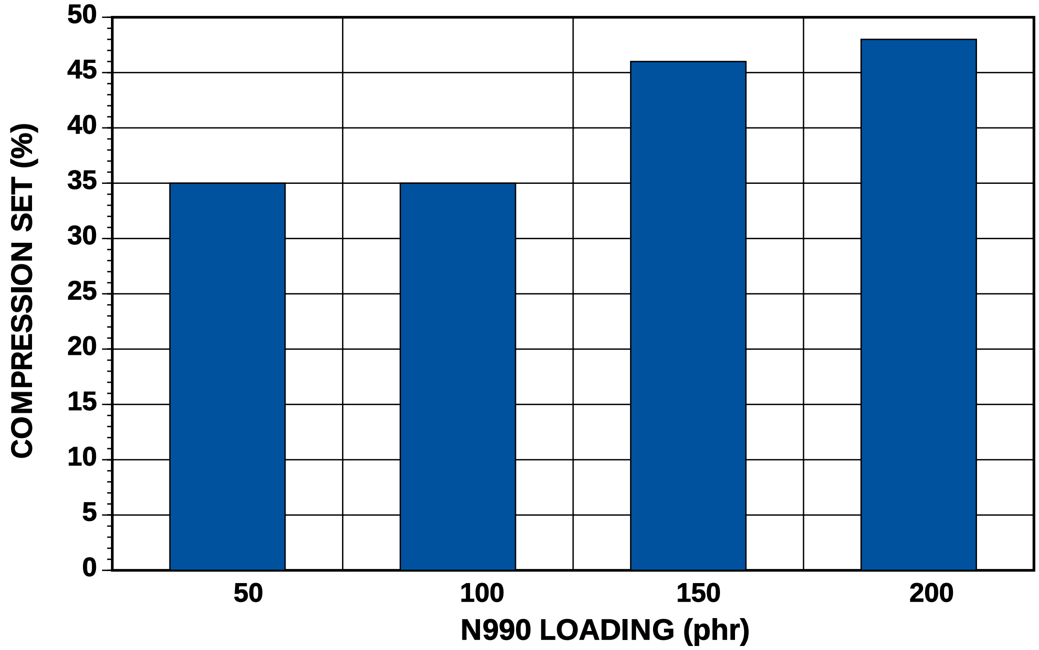


Source - R.T. Vanderbilt
Formula-See Appendix I

* - SMR-5

Figure 4a

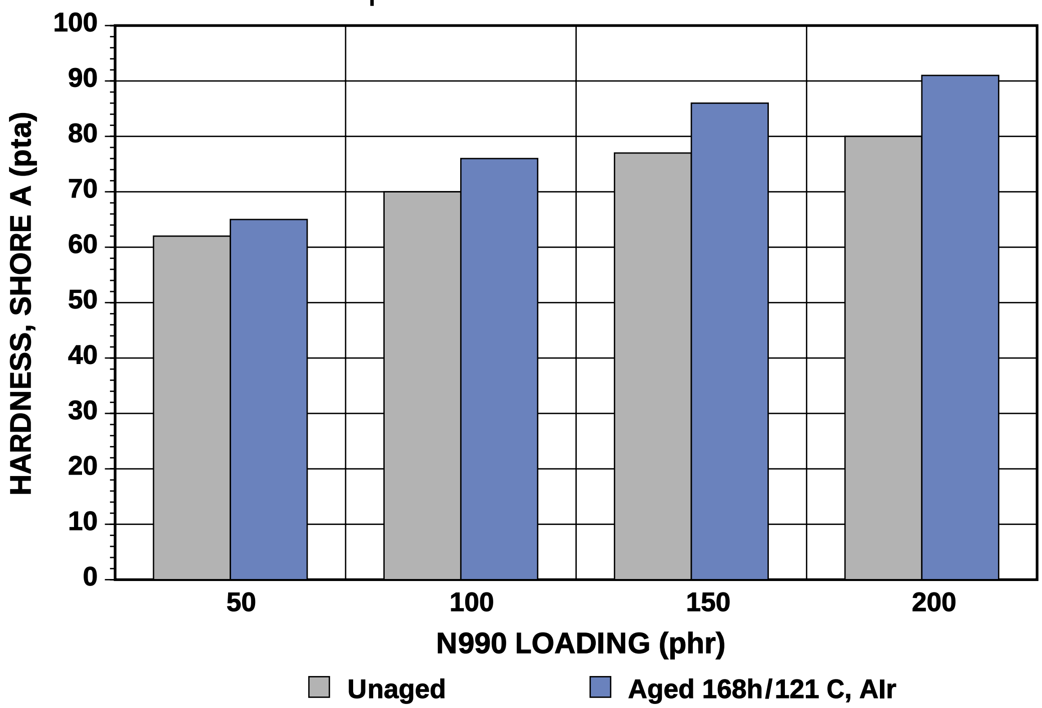
Effects of N990 in Chloroprene Rubber – compression set



Source - R.T. Vanderbilt
Formula-See Appendix I

Figure 4b

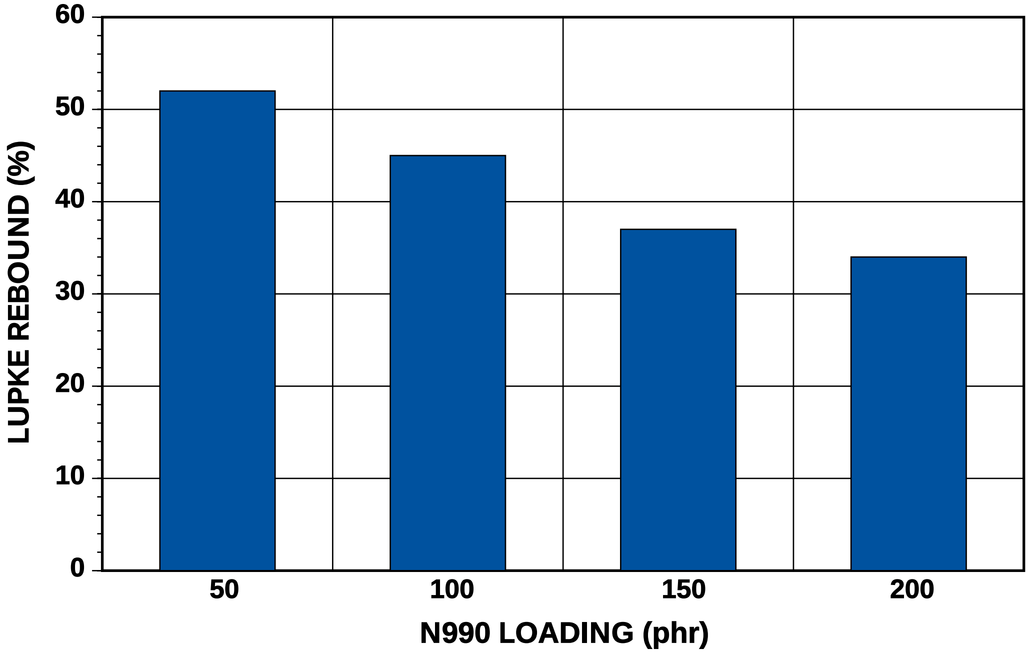
Effects of N990 in Chloroprene Rubber – hardness



Source - R.T. Vanderbilt
Formula-See Appendix I

Figure 4c

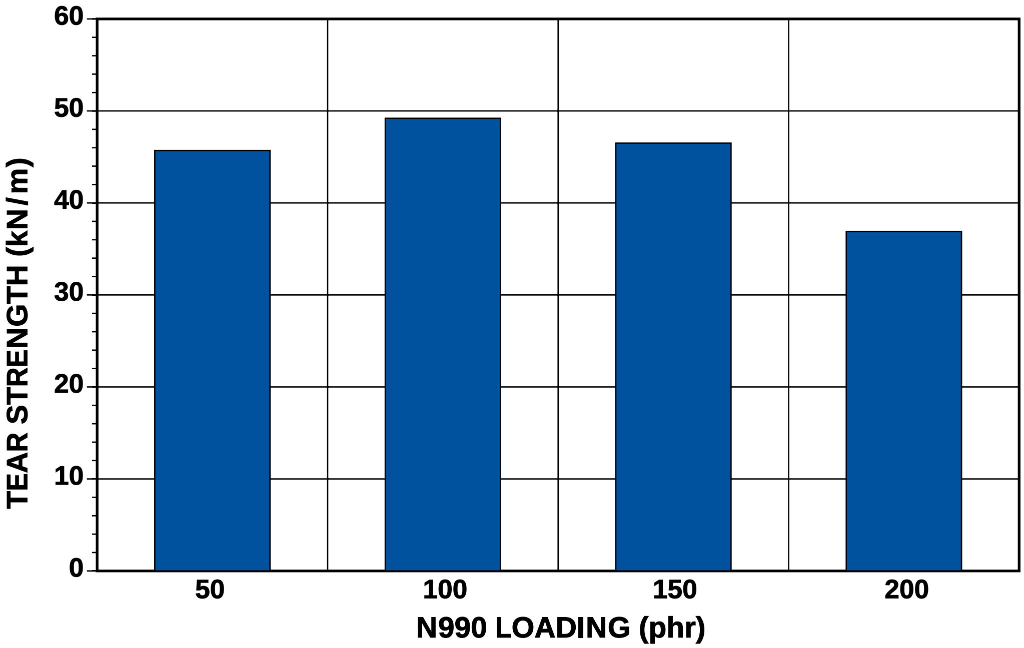
Effects of N990 in Chloroprene Rubber – resilience



Source - R.T. Vanderbilt
Formula-See Appendix I

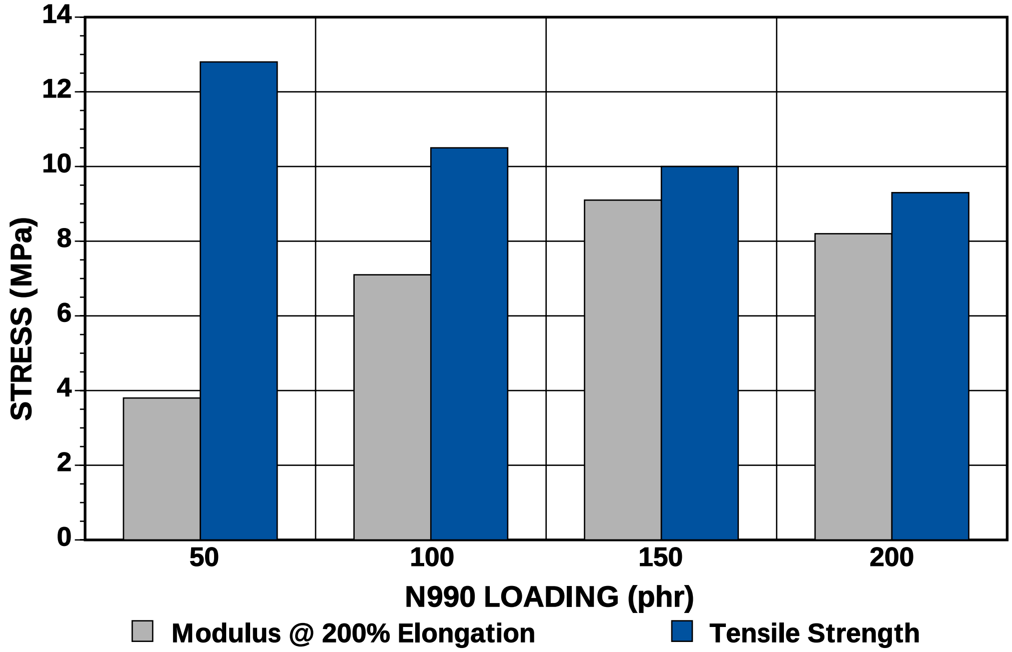
Figure 4d

Effects of N990 in Chloroprene Rubber – tear strength



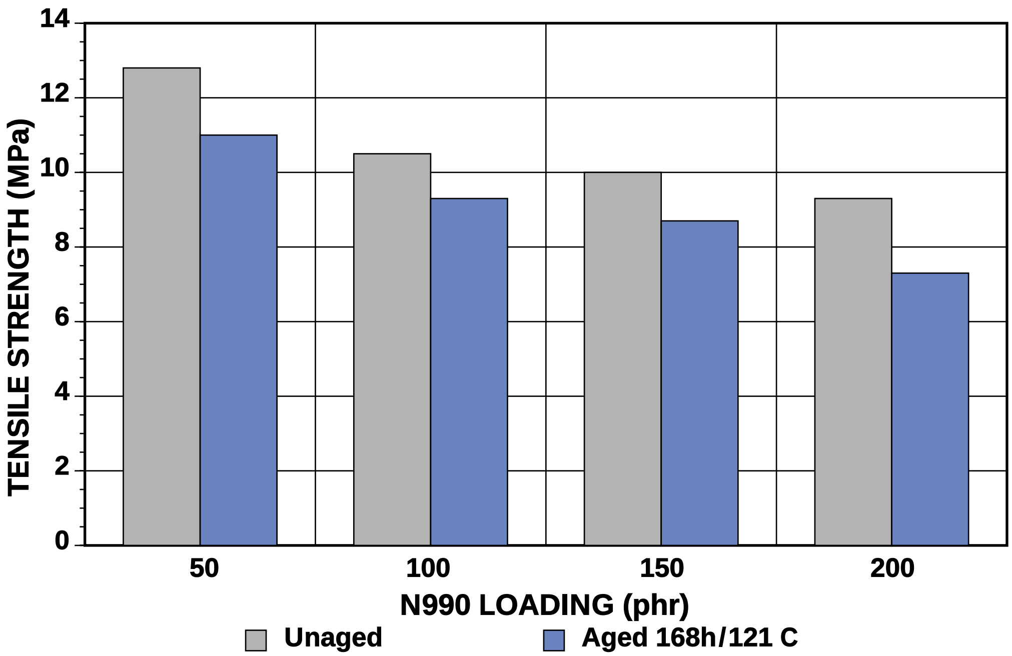
Source - R.T. Vanderbilt
Formula-See Appendix I

Figure 4e
Effects of N990 in Chloroprene Rubber – tensile properties



Source - R.T. Vanderbilt
Formula-See Appendix I

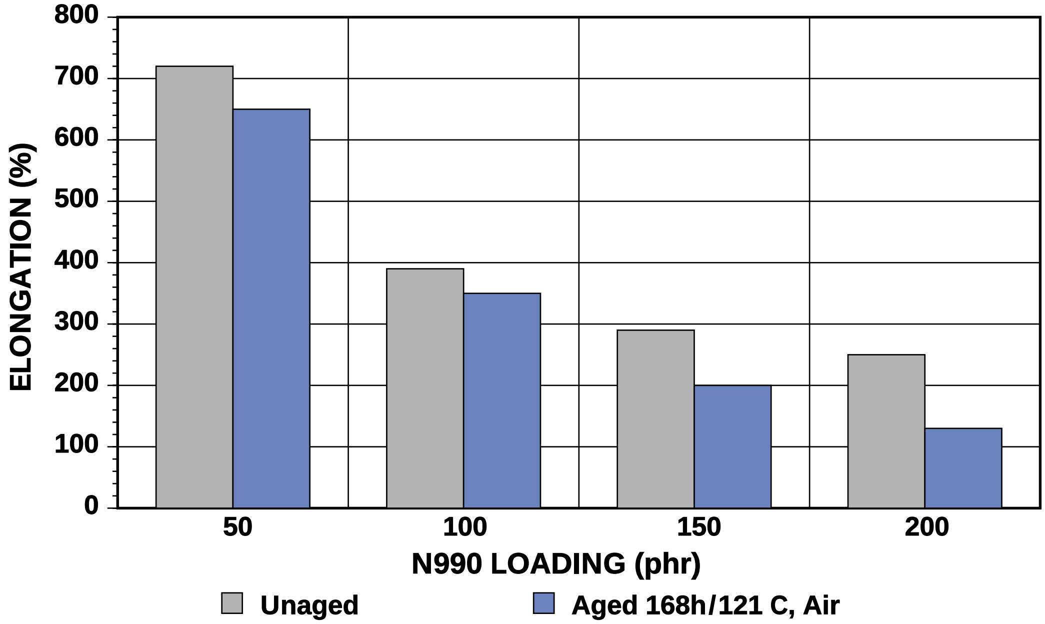
Figure 4f
Effects of N990 in Chloroprene Rubber – tensile strength



Source - R.T. Vanderbilt
Formula-See Appendix I

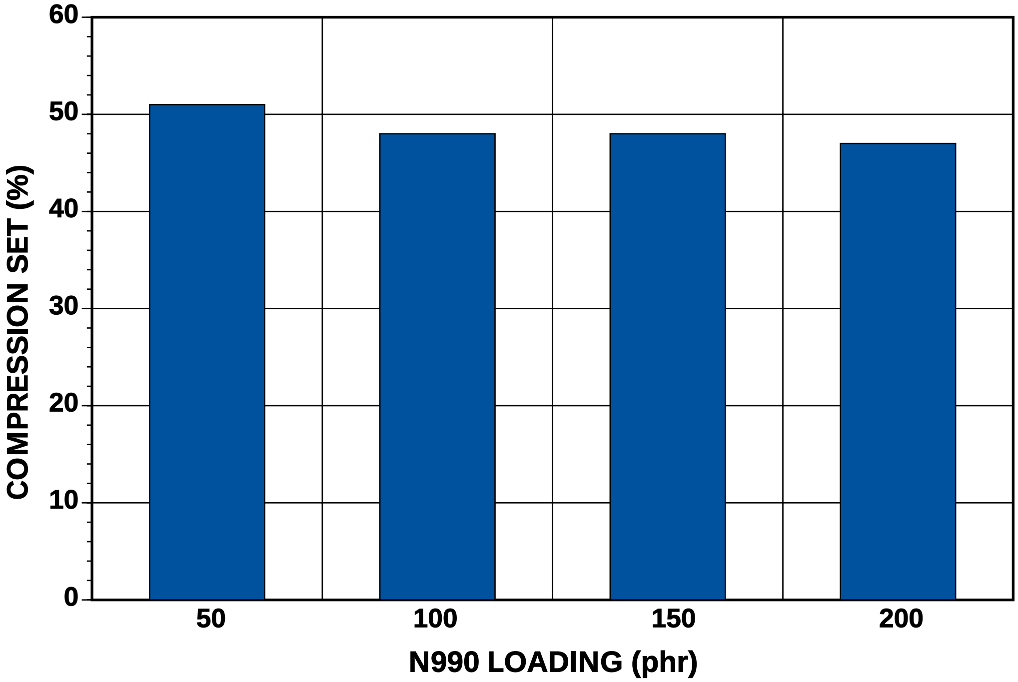
Figure 4g

Effects of N990 in Chloroprene Rubber – ultimate elongation



Source - R.T. Vanderbilt
Formula-See Appendix I

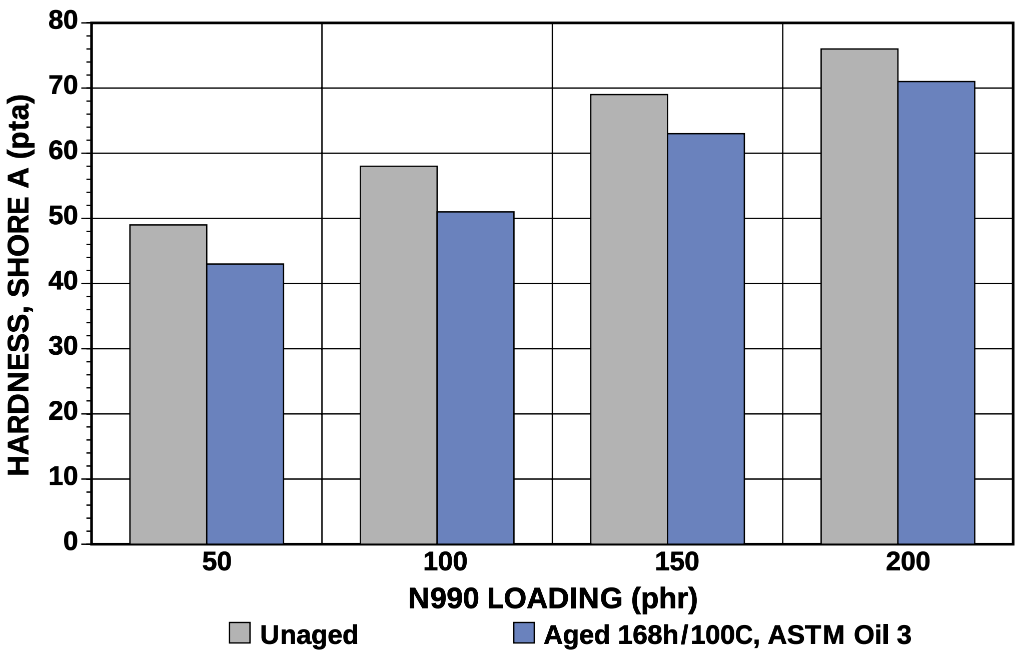
Figure 5a
Effects of N990 in Nitrile Rubber* – compression set



* - NIPOL 1042

Source - Cancarb
Formula-See Appendix II

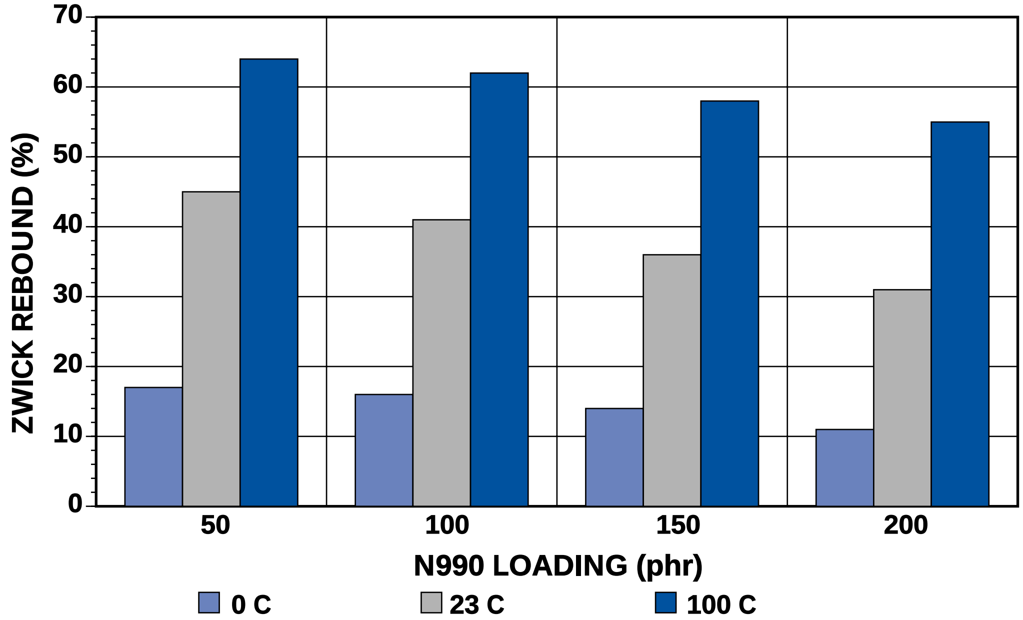
Figure 5b
Effects of N990 in Nitrile Rubber* – hardness



* - NIPOL 1042

Source - Cancarb
Formula-See Appendix II

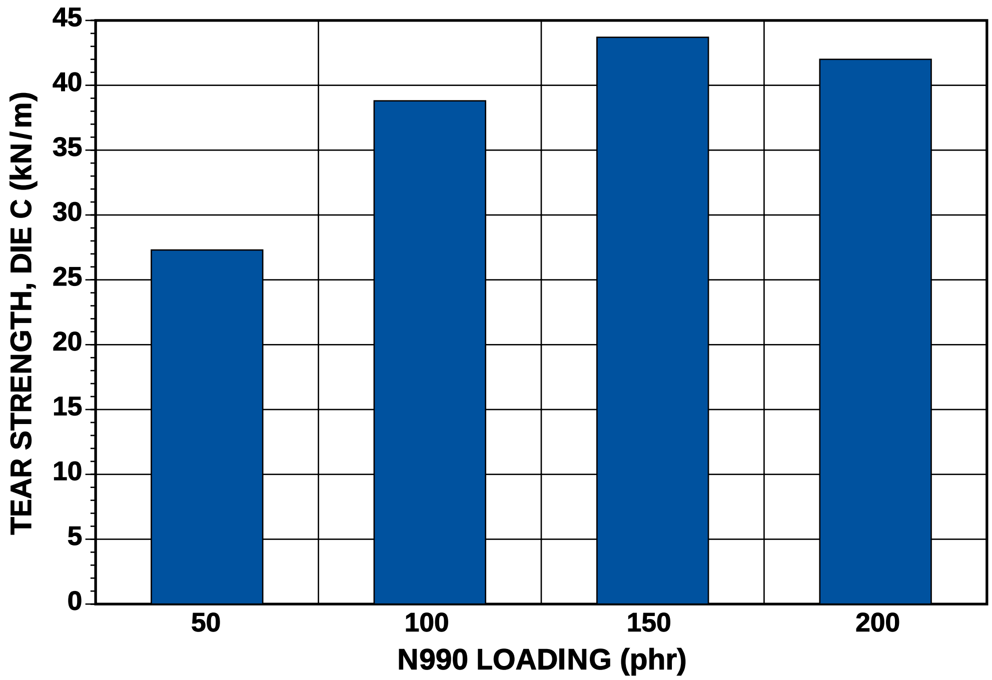
Figure 5c
Effects of N990 in Nitrile Rubber* – resilience



* - NIPOL 1042

Source - Cancarb
Formula-See Appendix II

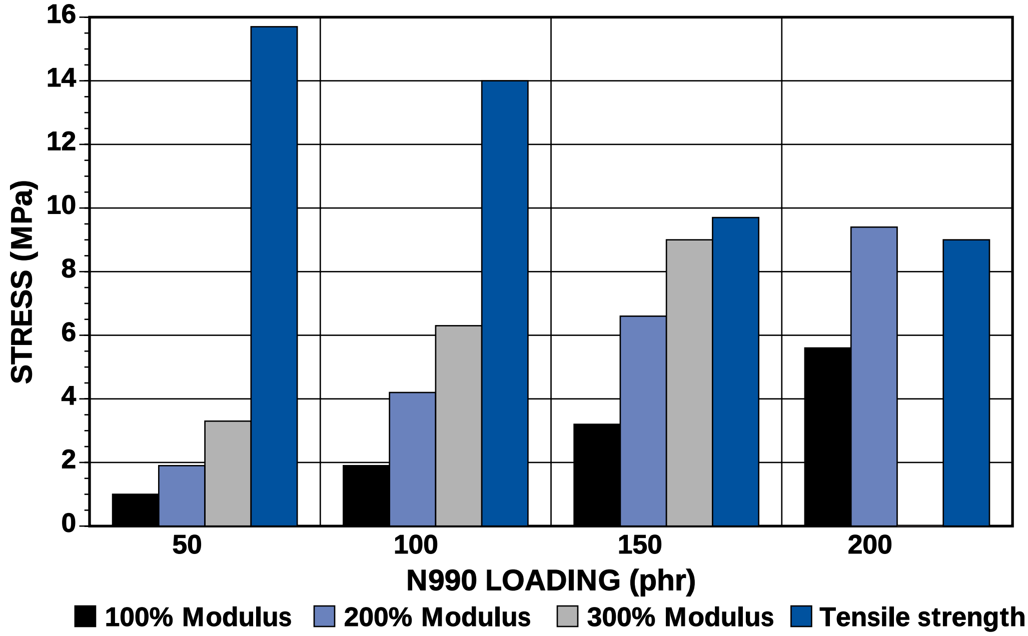
Figure 5d
Effects of N990 in Nitrile Rubber* – tear strength



* - NIPOL 1042

Source - Cancarb
Formula-See Appendix I I

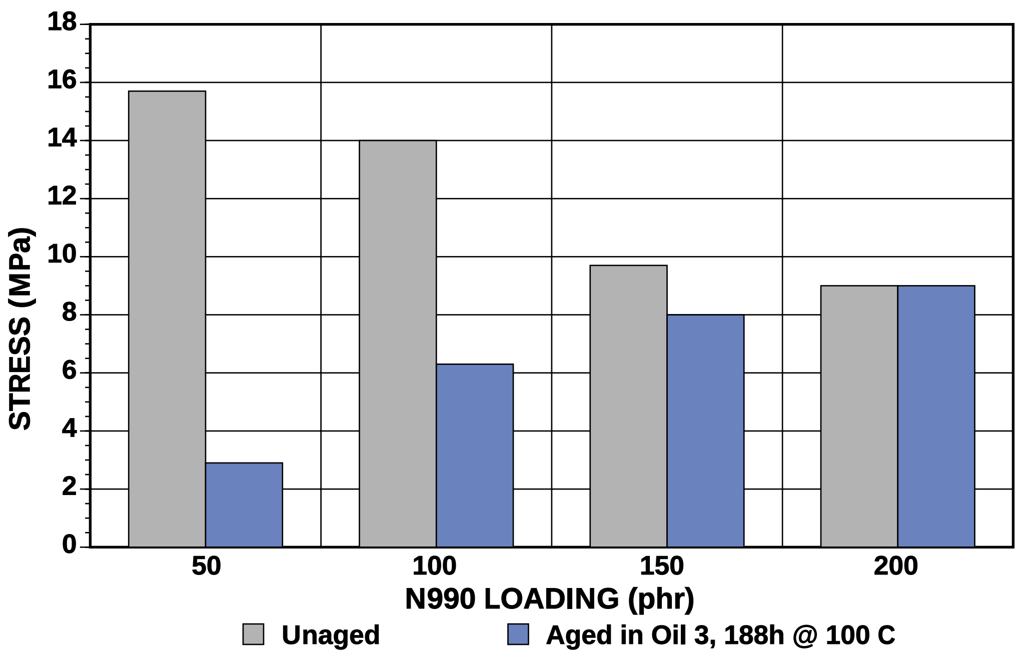
Figure 5e
Effects of N990 in Nitrile Rubber* – tensile properties



* - NIPOL 1042

Source - Cancarb
Formula-See Appendix II

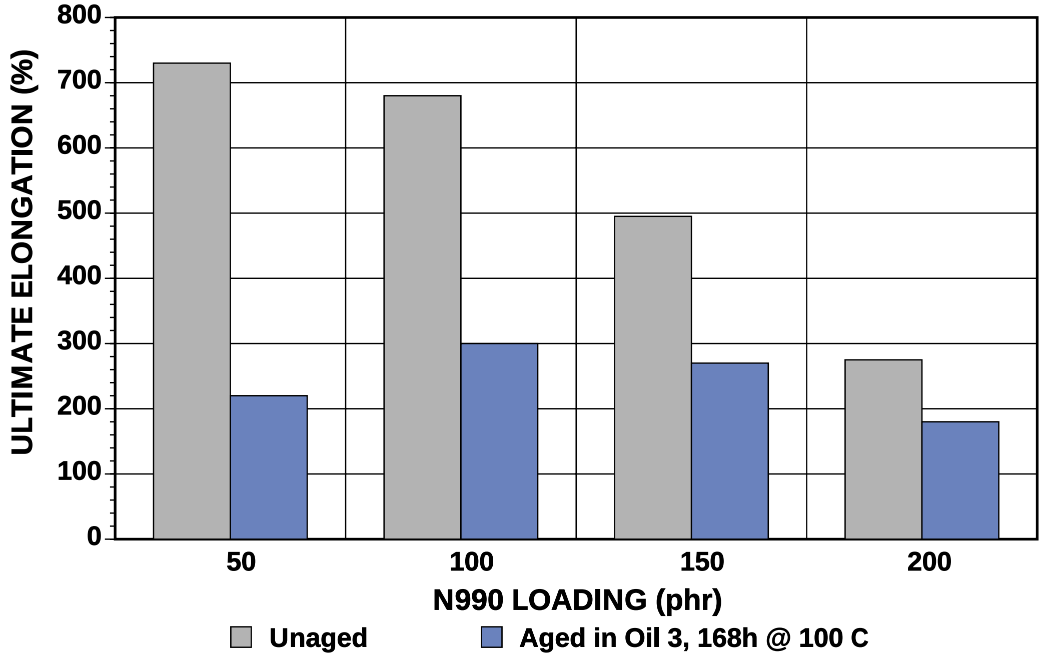
Figure 5f
Effects of N990 in Nitrile Rubber* – tensile strength



* - NIPOL 1042

Source - Cancarb
Formula-See Appendix II

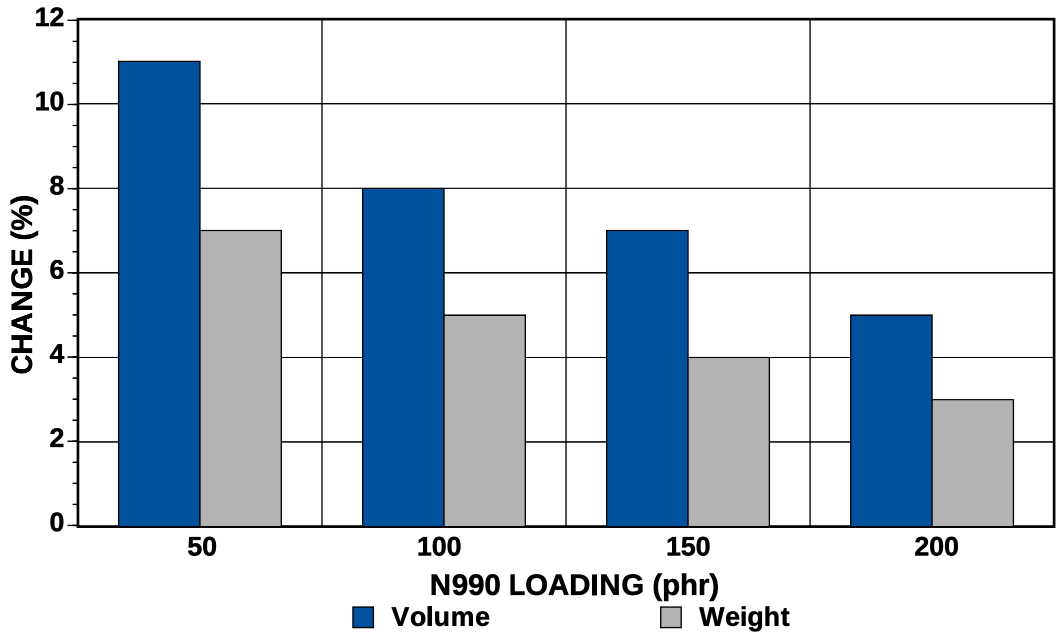
Figure 5g
Effects of N990 in Nitrile Rubber* – ultimate elongation



Source - Cancarb
Formula-See Appendix II

* - NIPOL 1042

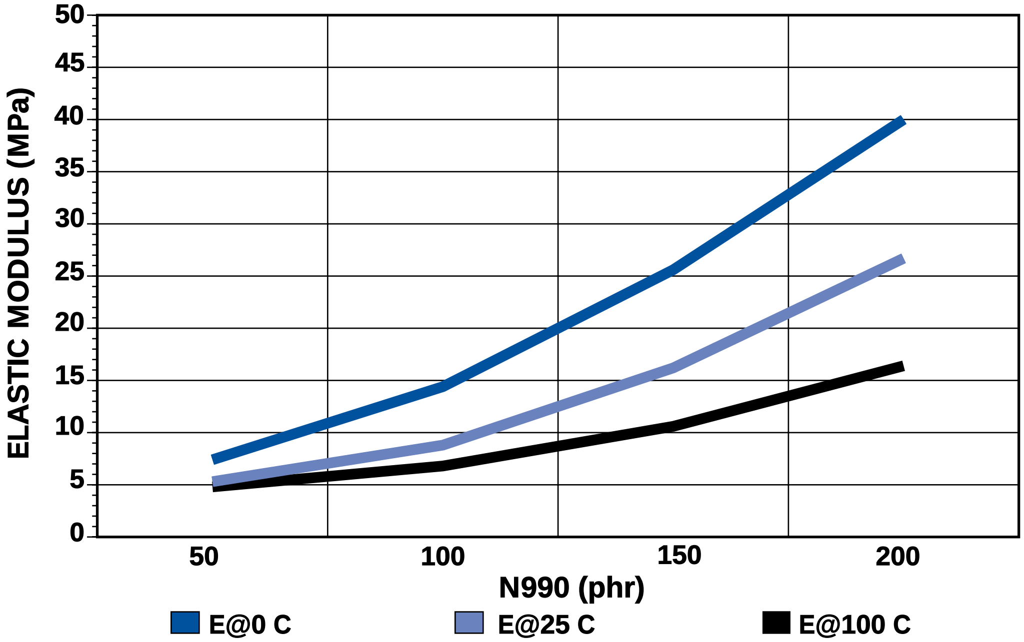
Figure 5h
Effects of N990 in Nitrile Rubber* – volume/weight



Aged in ASTM Oil 3, 168h @ 100 C
* - NIPOL 1042

Source - Cancarb
Formula-See Appendix II

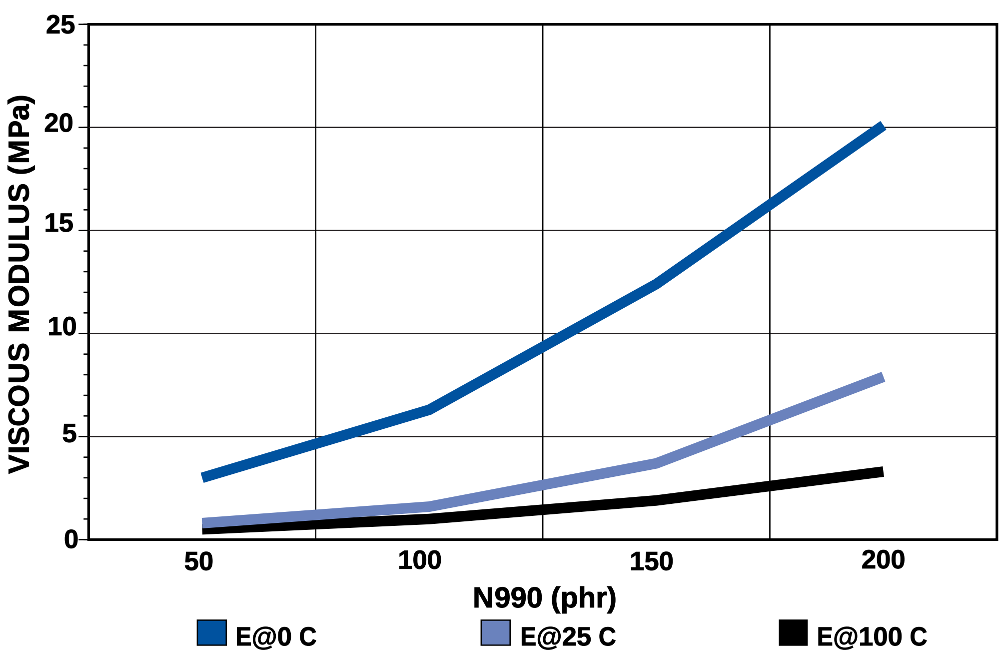
Figure 5i
Effects of N990 in Nitrile Rubber* – elastic modulus



Source - Cancarb
Formula - See Appendix II

* - NIPOL 1042

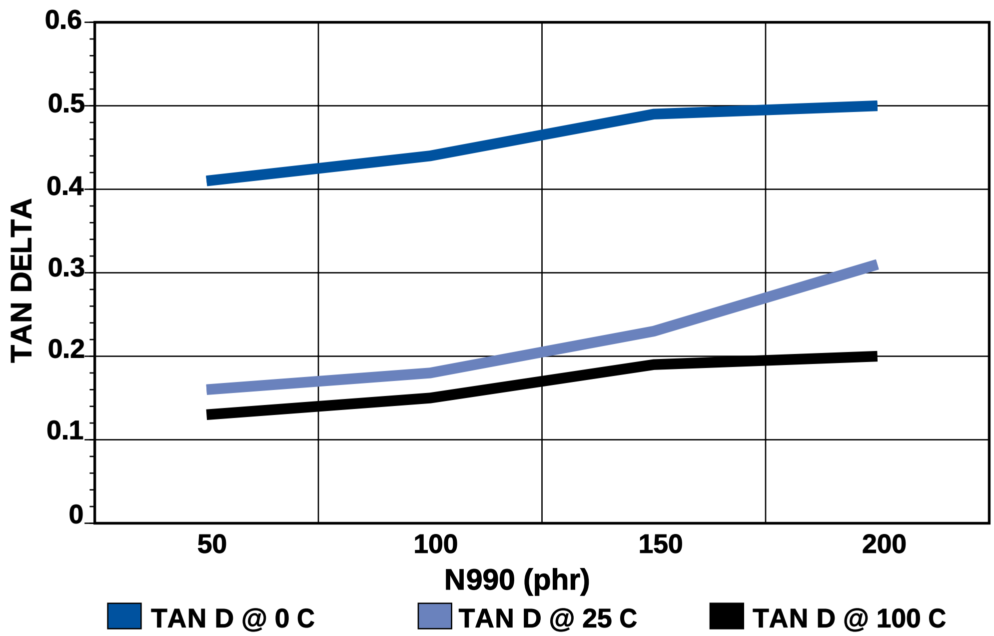
Figure 5j
Effects of N990 in Nitrile Rubber* – viscous modulus



Source - Cancarb
Formula - See Appendix II

* - NIPOL 1042

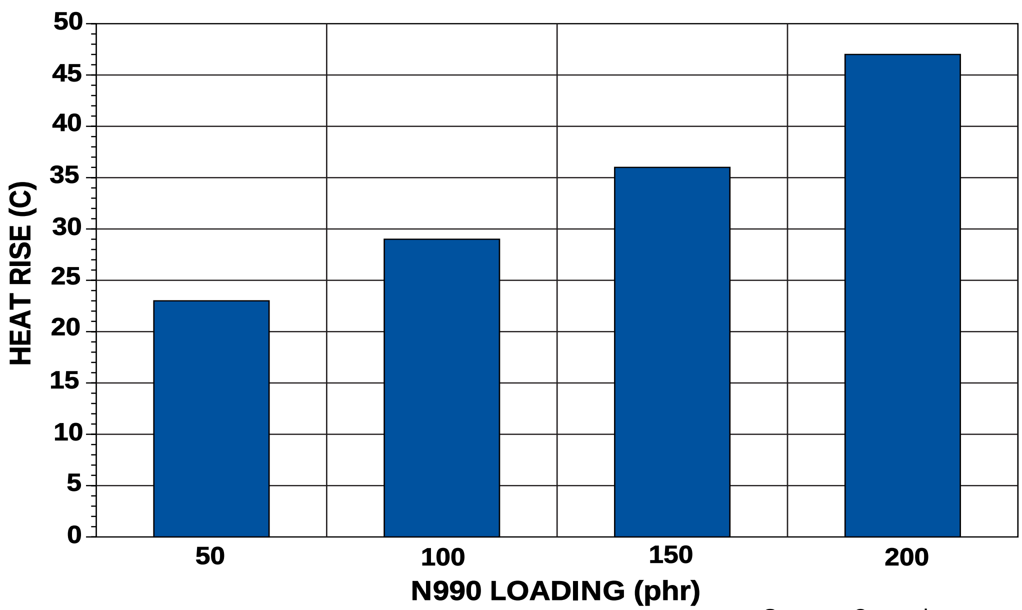
Figure 5k
Effects of N990 in Nitrile Rubber* – tan delta



* - NIPOL 1042

Source - Cancarb
Formula - See Appendix I

Figure 5l
Effects of N990 in Nitrile Rubber* – FATIGUE

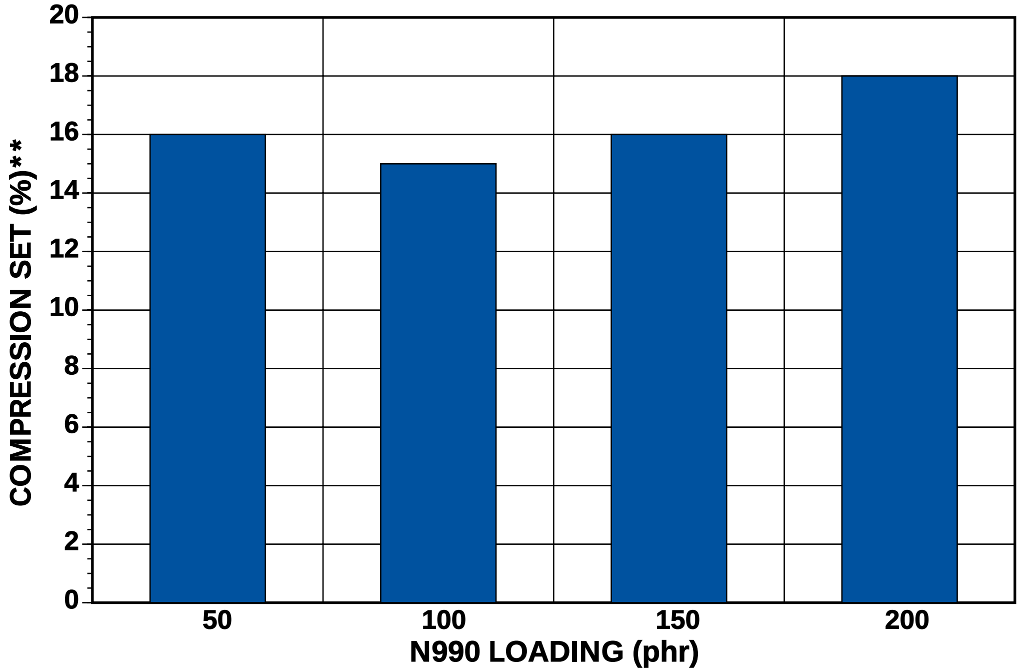


Goodrich Flexometer @ 55 C
* - NIPOL 1042

Source - Cancarb
Formula - See Appendix II

Figure 6a

Effects of N990 in Polyacrylate Rubber* – compression set

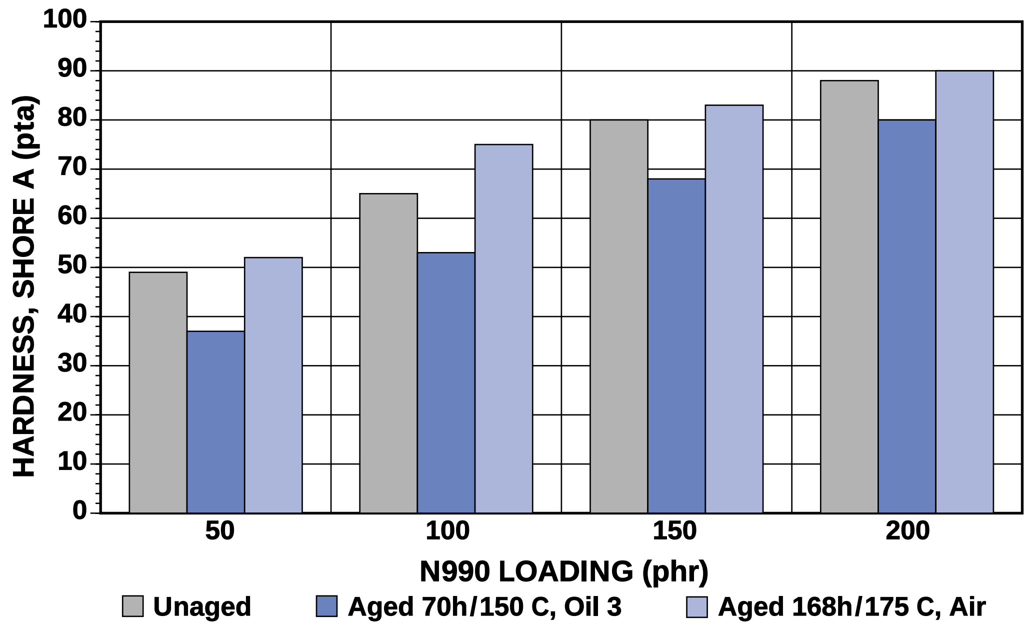


* - HYTEMP 4051 EP
** - 70h @ 100 C

Source - Cancarb
Formula-See Appendix II

Figure 6b

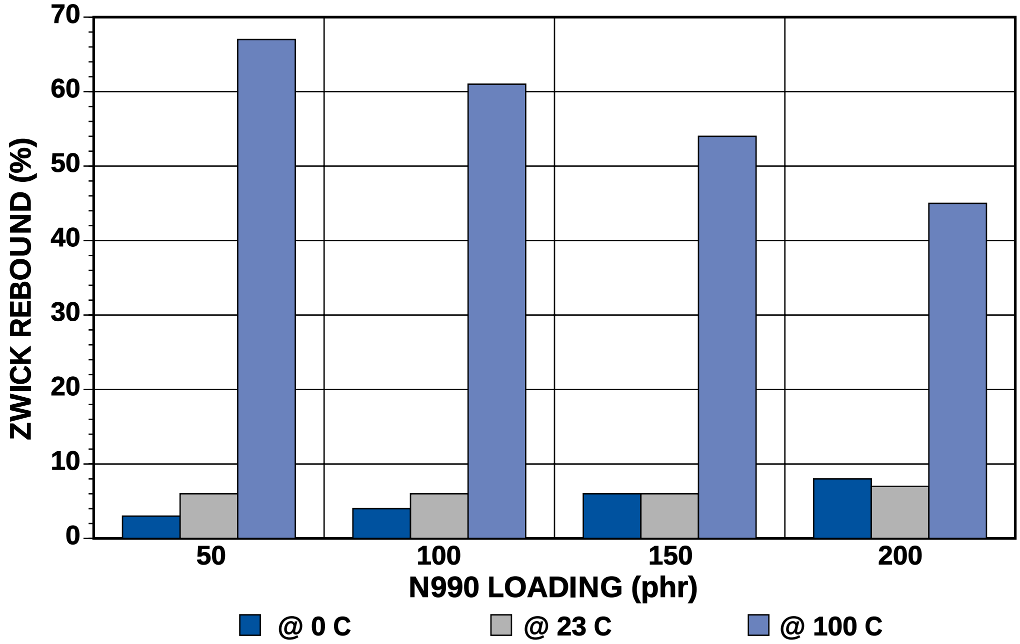
Effects of N990 in Polyacrylate Rubber* – hardness



Source - Cancarb
Formula-See Appendix II

* - HYTEMP 4051 EP

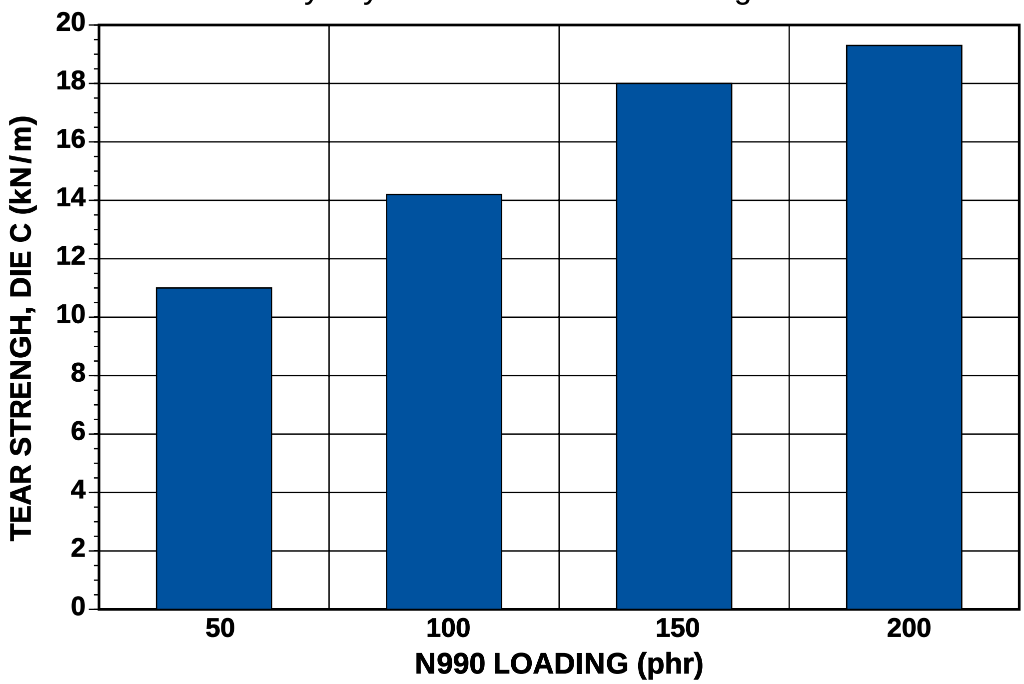
Figure 6c
Effects of N990 in Polyacrylate Rubber* – resilience



* - HYTEMP 4051 EP

Source - Cancarb
Formula-See Appendix II

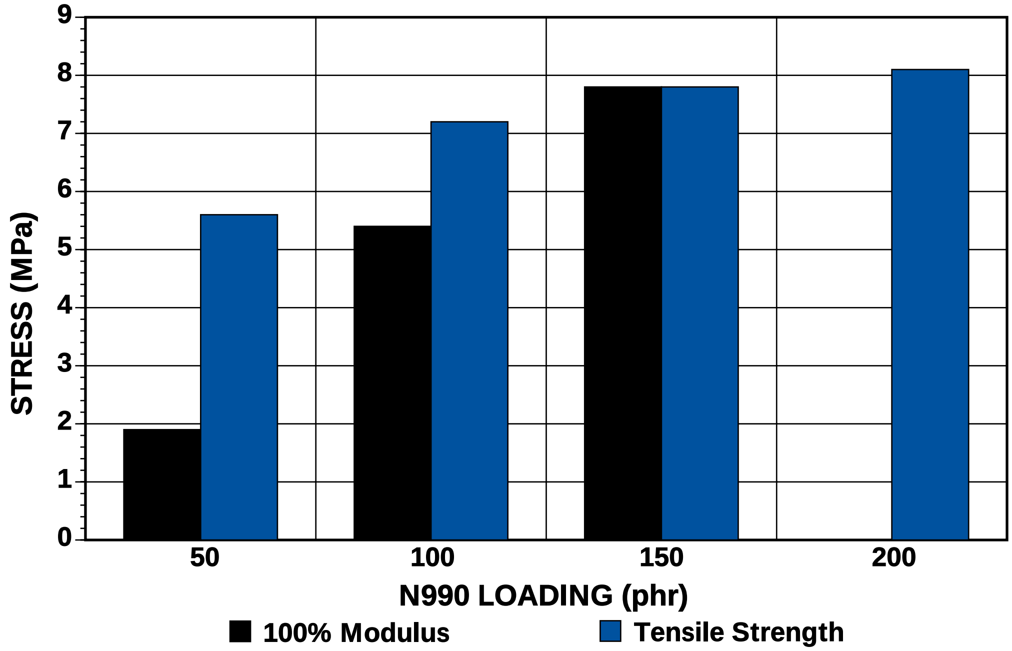
Figure 6d
Effects of N990 in Polyacrylate Rubber* – tear strength



* - HYTEMP 4051 EP

Source - Cancarb
Formula-See Appendix II

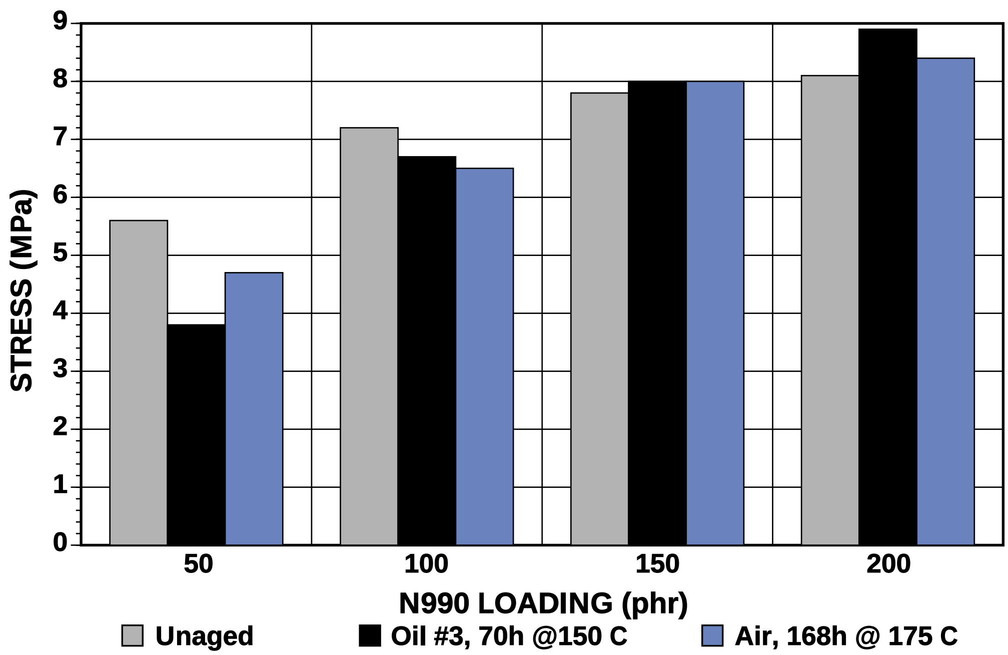
Figure 6e
Effects of N990 in Polyacrylate Rubber* – tensile properties



Source - Cancarb
See Appendix II

* - HYTEMP 4051 EP

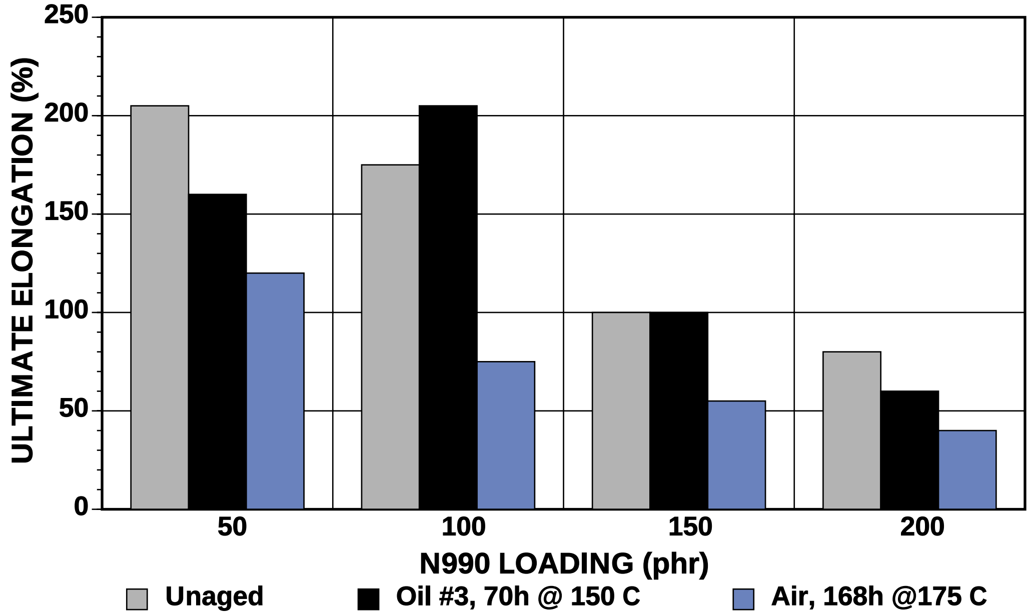
Figure 6f
Effects of N990 in Polyacrylate Rubber* – tensile strength



Source - Cancarb
See Appendix II

* - HYTEMP 4051 EP

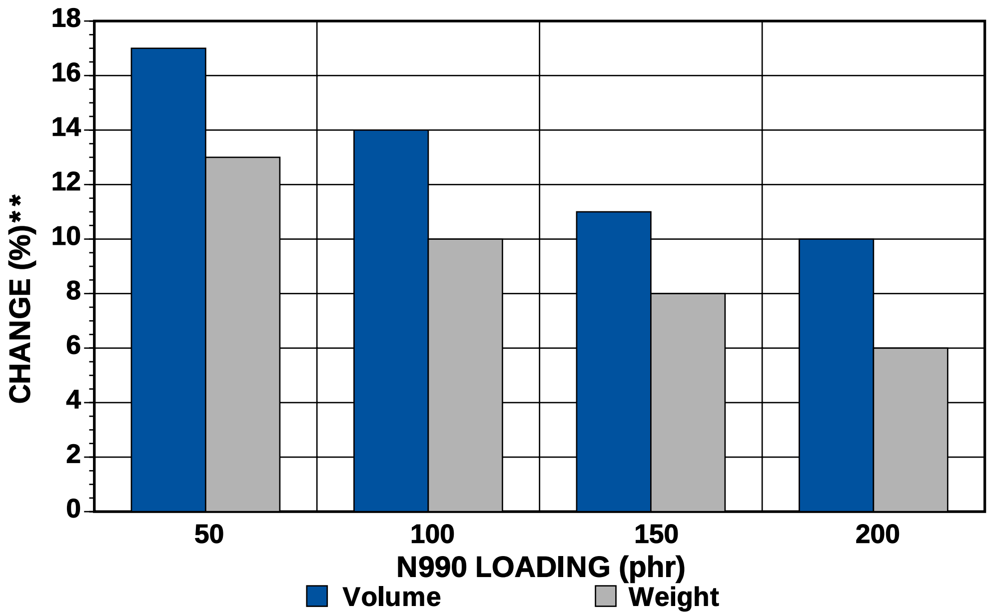
Figure 6g
Effects of N990 in Polyacrylate Rubber* - ultimate elongation



* - HYTEMP 4051 EP

Source - Cancarb
Formula-See Appendix II

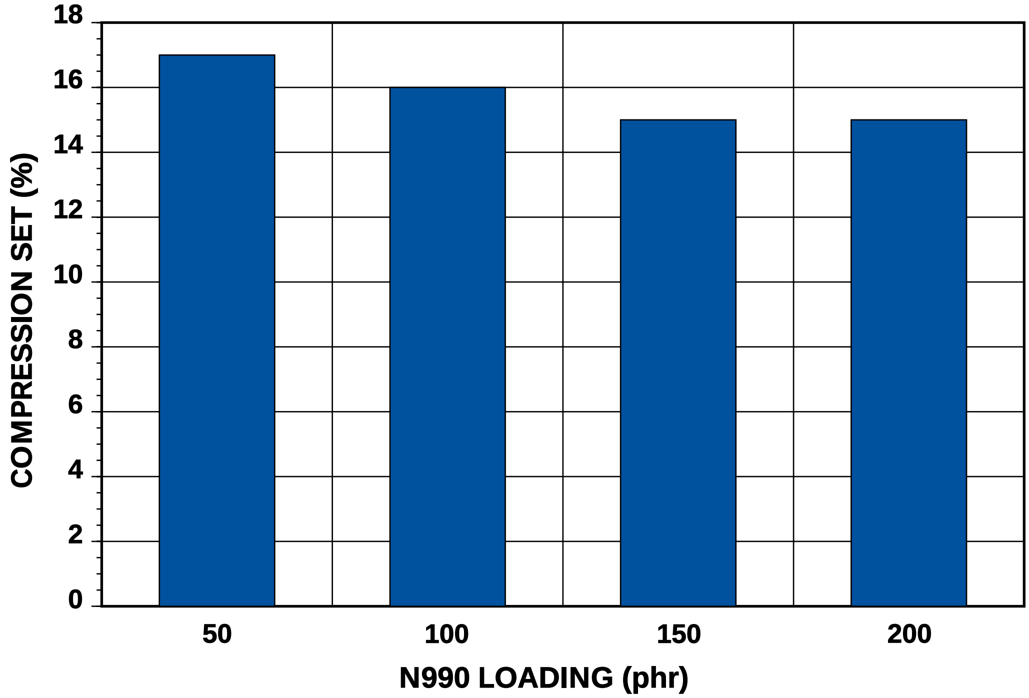
Figure 6h
Effects of N990 in Polyacrylate Rubber* – volume/weight



* - HYTEMP 4051 EP
** - Aged in Oil 3, 70h @ 150 C

Source - Cancarb
Formula-See Appendix II

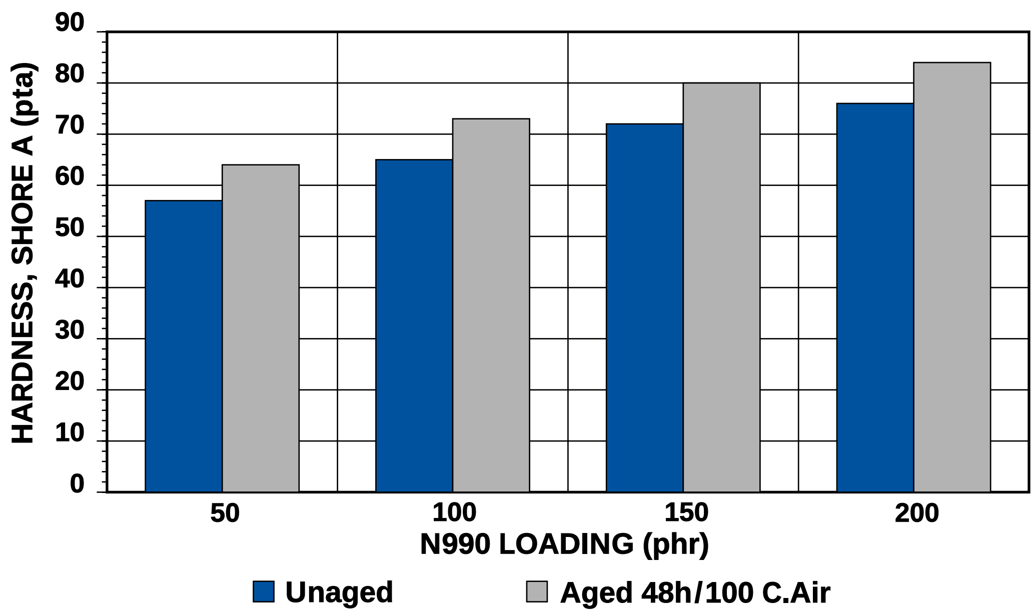
Figure 7a
Effects of N990 in Styrene Butadiene Rubber* – compression set



*- SBR-1500

Source – R.T. Vanderbilt
Formula – See Appendix I

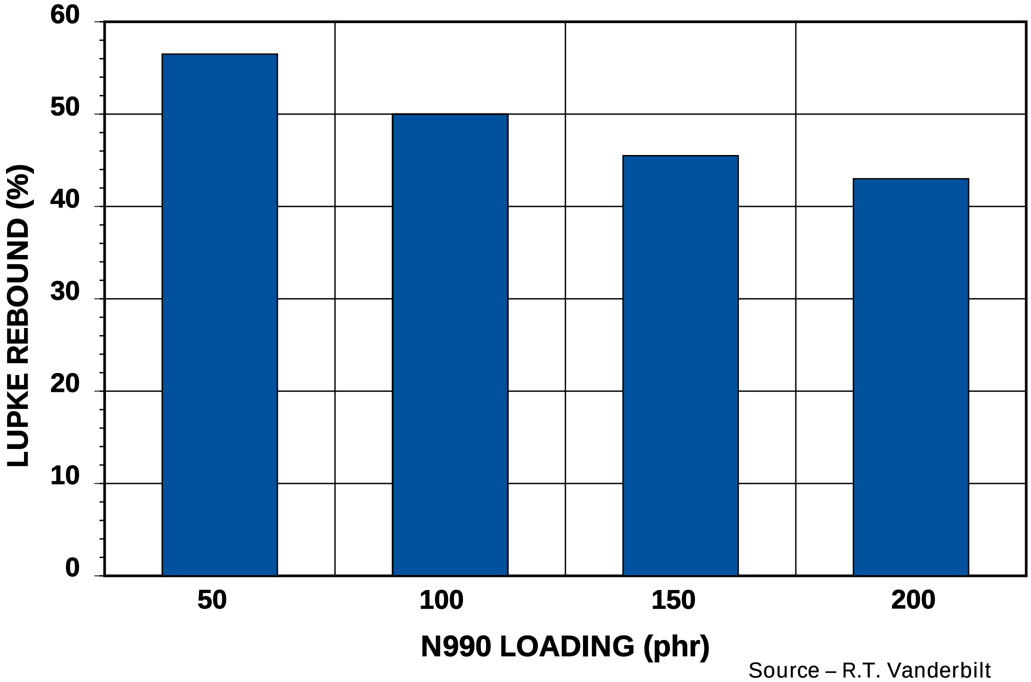
Figure 7b
Effects of N990 in Styrene Butadiene Rubber* – hardness



*- SBR-1500

Source – R.T. Vanderbilt
Formula – See Appendix I

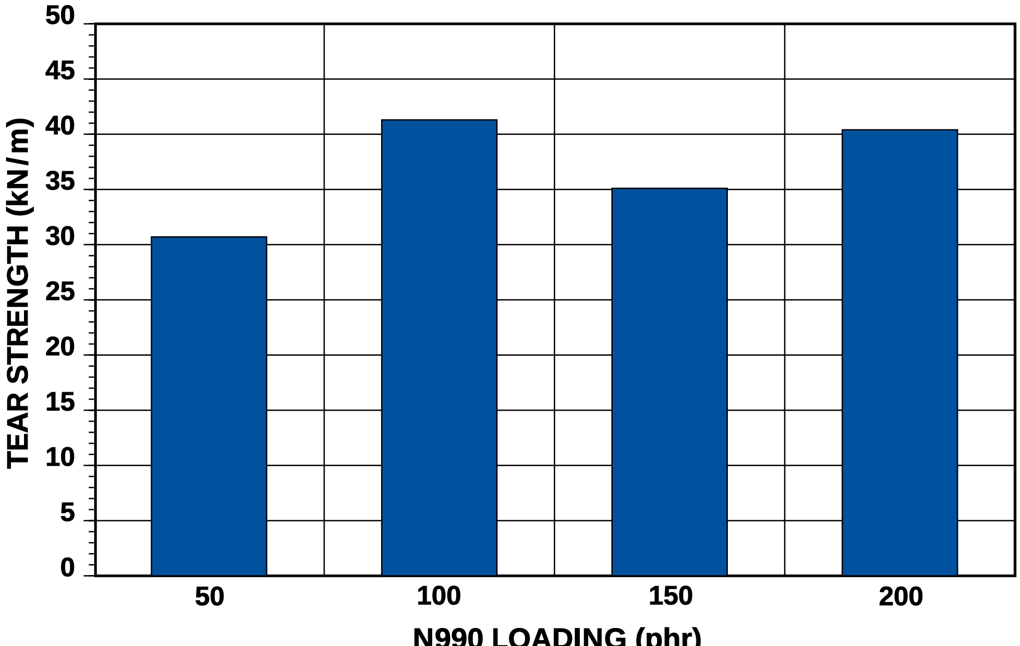
Figure 7c
Effects of N990 in Styrene Butadiene Rubber* – resilience



*- SBR-1500

Source – R.T. Vanderbilt
Formula – See Appendix I

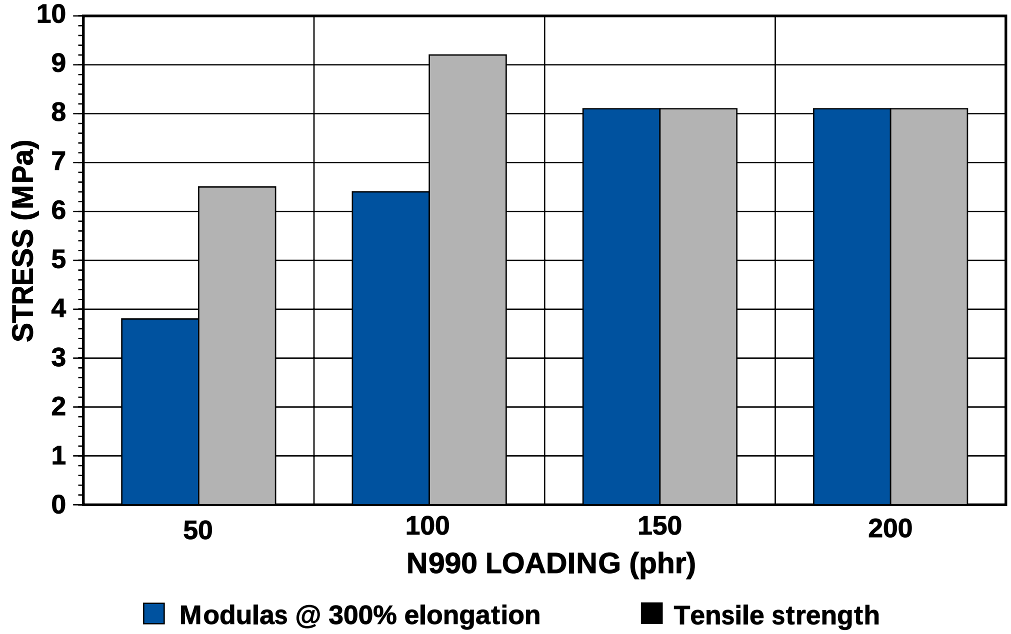
Figure 7d
Effects of N990 in Styrene Butadiene Rubber* – tear strength



*- SBR-1500

Source – R.T. Vanderbilt
Formula – See Appendix I

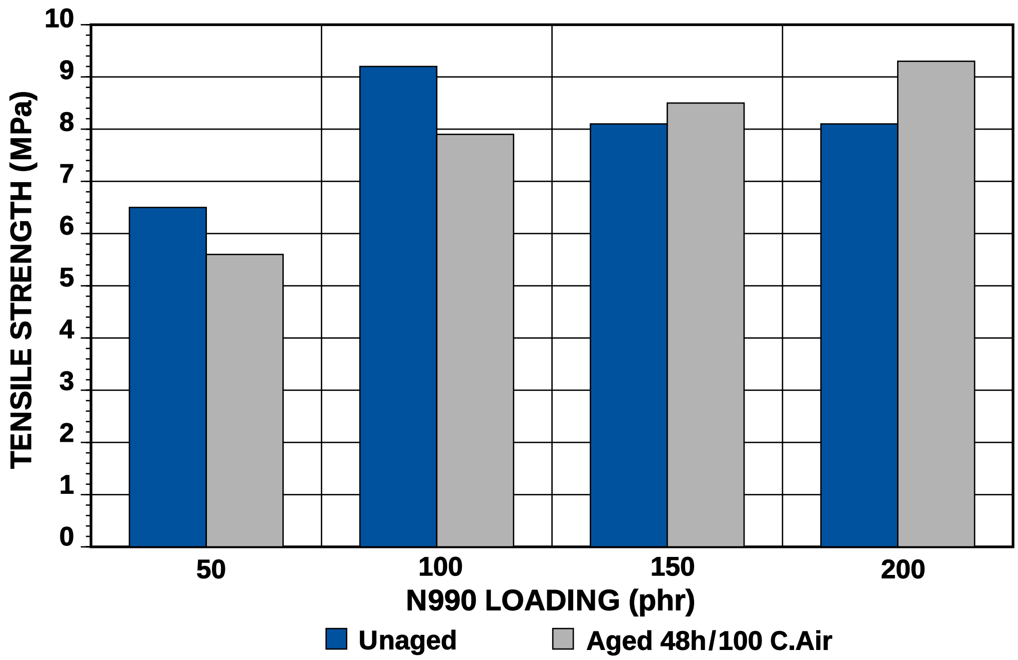
Figure 7e
Effects of N990 in Styrene Butadiene Rubber* – tensile properties



Source – R.T. Vanderbilt
Formula – See Appendix I

*- SBR-1500

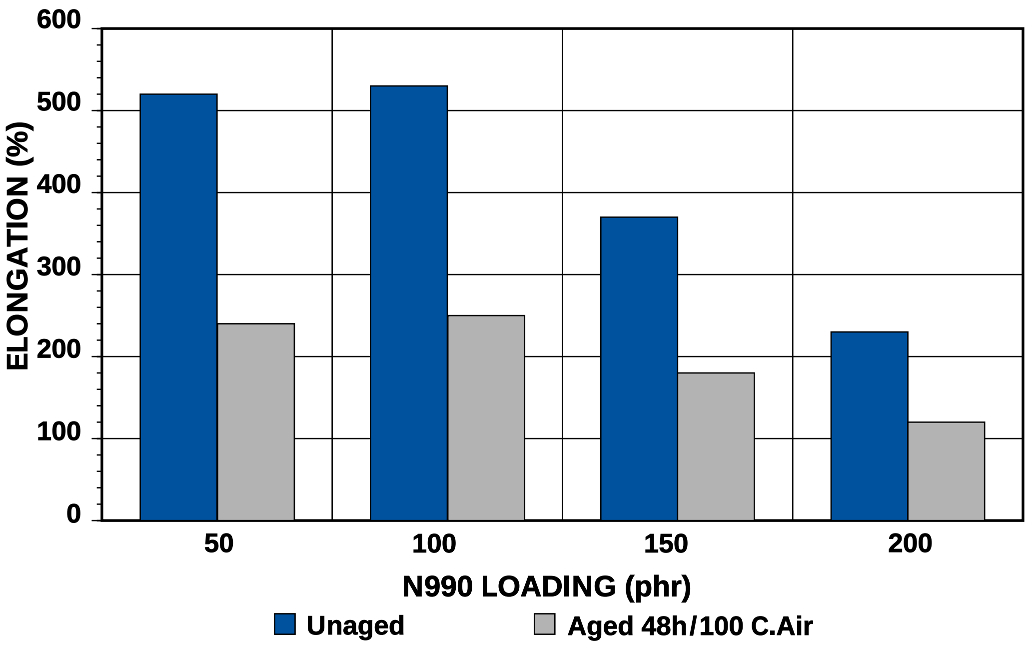
Figure 7f
Effects of N990 in Styrene Butadiene Rubber* – tensile strength



Source – R.T. Vanderbilt
Formula – See Appendix I

*- SBR-1500

Figure 7g
Effects of N990 in Styrene Butadiene Rubber* – ultimate elongation



*- SBR-1500

Source – R.T. Vanderbilt
Formula – See Appendix I