



Nylon Corporation of America

Nylon Nanocomposite (nanoSEAL™) for Improved Fuel Permeation Performance

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Nylon Corporation of America

Announces its latest innovation

nanoSEAL™

nanoSEAL™ What is it?

nanoSEAL™ is a novel, specialty engineered Nylon (PA6) **nanocomposite** which has been designed to enable fuel tank and hose manufacturers meet the California (CARB) and EPA requirements for fuel permeation.

nanoSEAL process like neat PA6 and can be run on existing equipment with no modification.

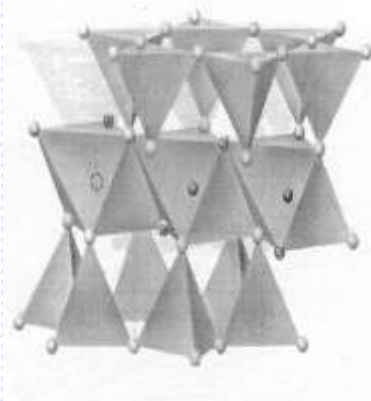
What are nanocomposites?

nanocomposites: a new class of plastics containing a highly refined form of nanoclay that is uniformly dispersed in the polymer matrix.

The nano-sized clay particles are composed of montmorillonite minerals. The nanoclay acts as a barrier material which dramatically prevents vapors and liquids from penetrating thru the **nanoseal™** resin.

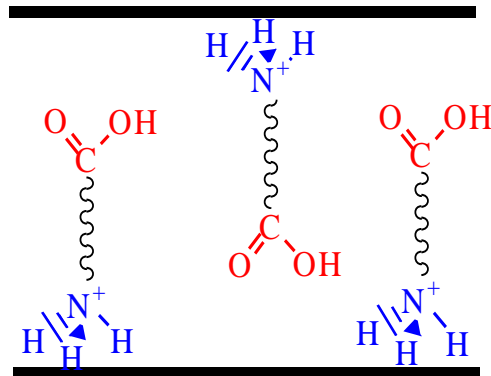
What are nanoclays?

Nanoclays are surface modified montmorillonite clays, or masterbatches containing modified clays, that are utilized to make a nanocomposite. Nanoclay dimensions are in the range of 200-500 nm (10^{-9} meters)

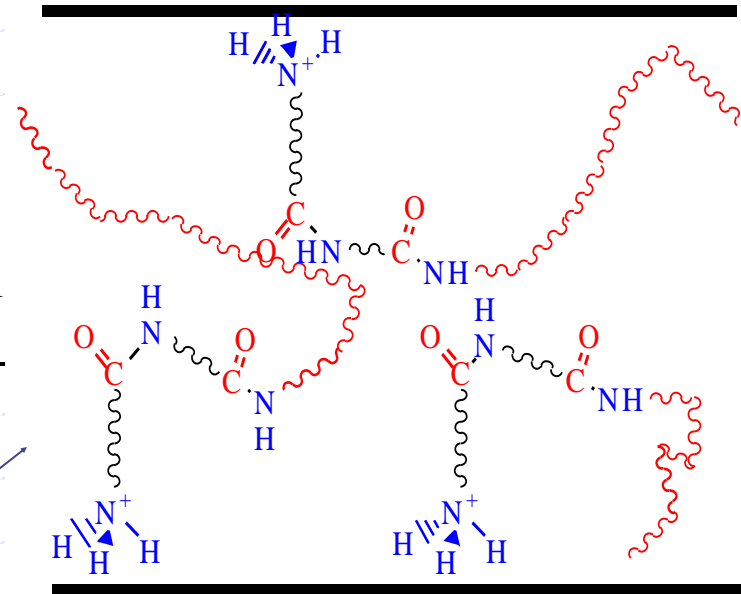
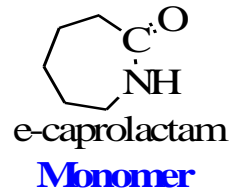


nanoSEAL™ *Chemical Structure*

In-situ Batch Polymerization



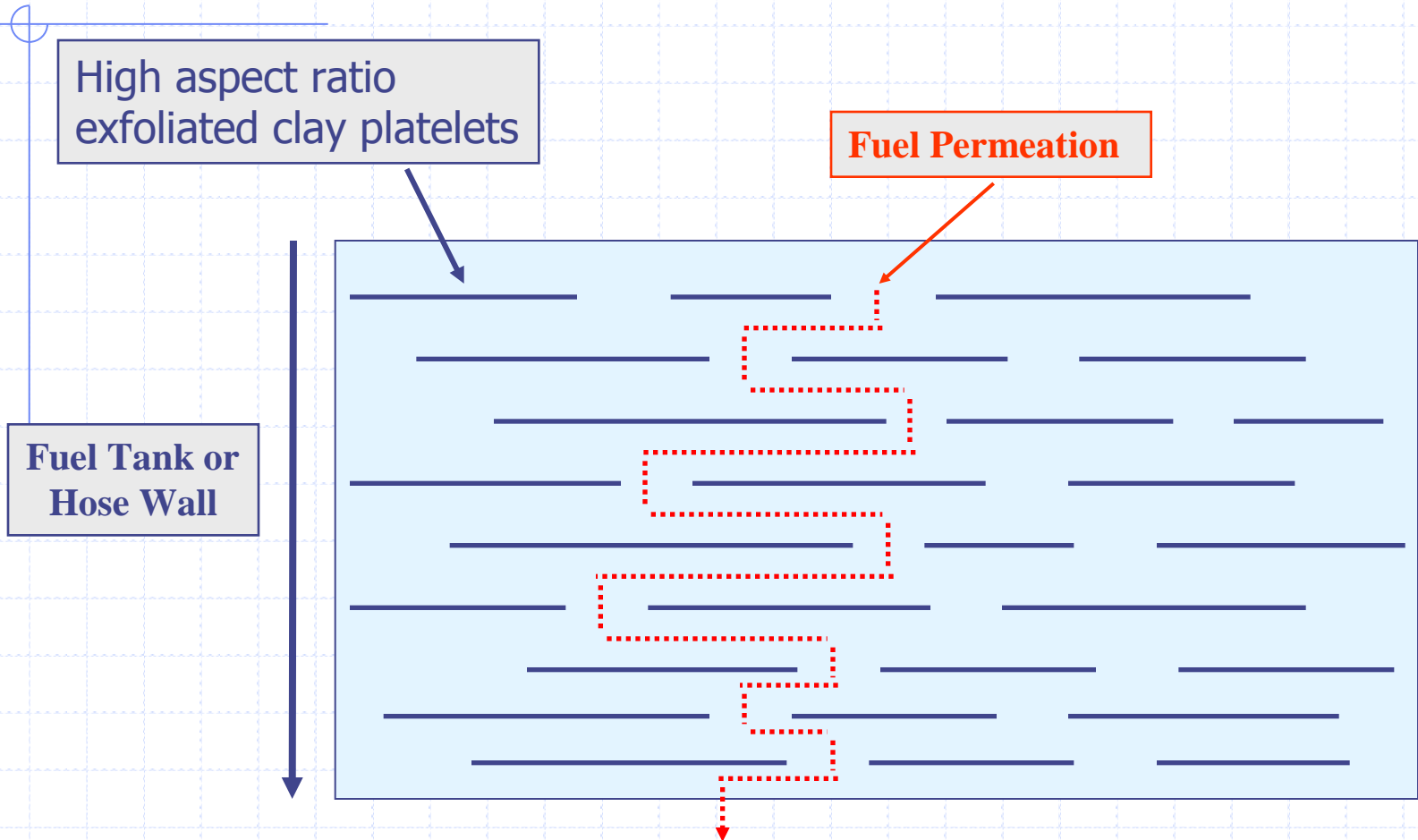
Surface Treated Clay : Nanomer



Nylon 6 Nanocomposite

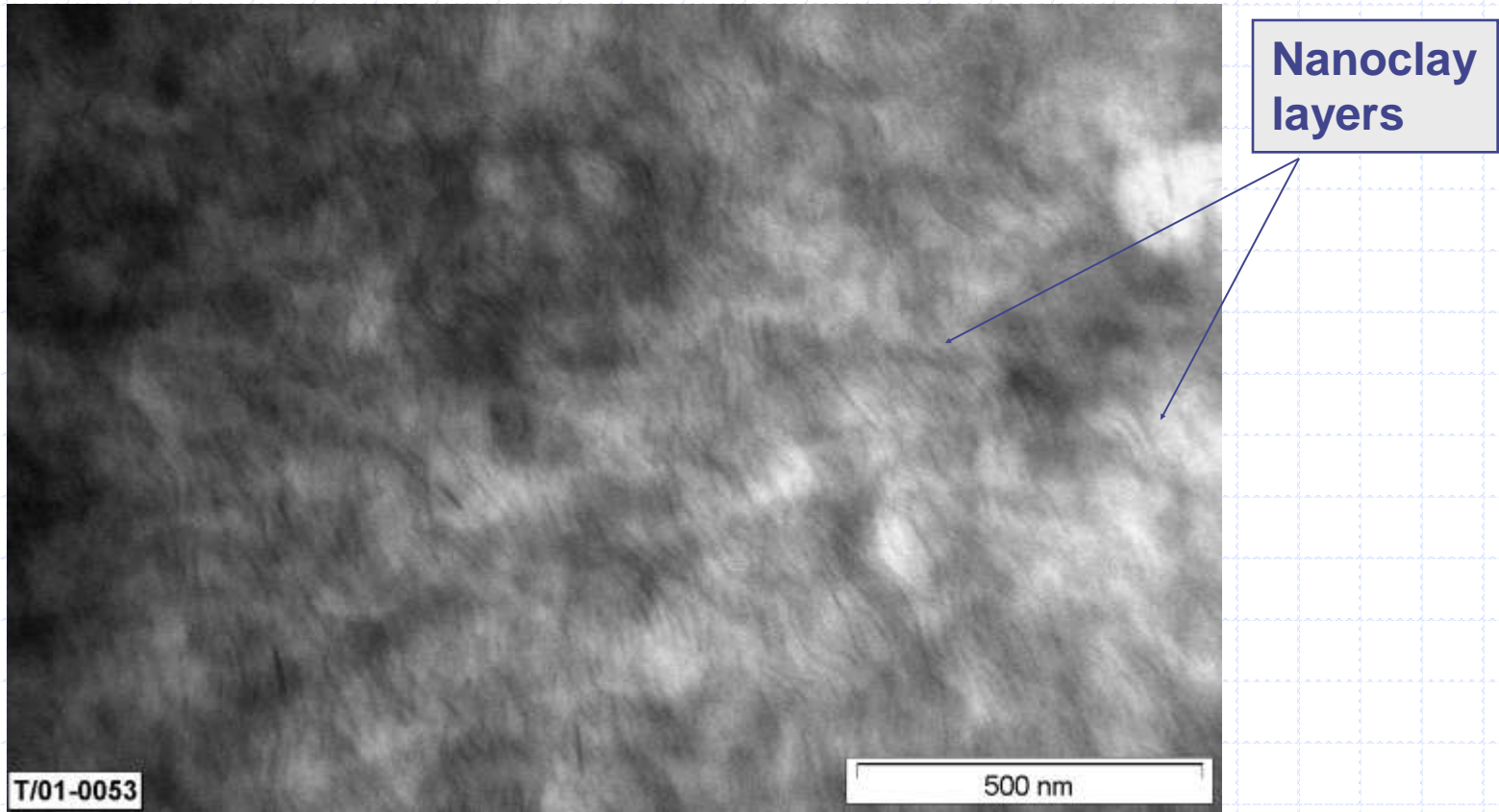
The nanoclay is fully exfoliated by in-situ batch polymerization and tethers to the PA-6 polymer chain. This is the only way to completely exfoliate clay platelets.

nanoSEAL™ *Barrier Resistance*



The nanoclay creates a tortuous path for the fuel, water vapor, oxygen, or carbon dioxide

TEM of nanocomposite



PA6 containing 8% Nanoclay

SEM of nanoclay

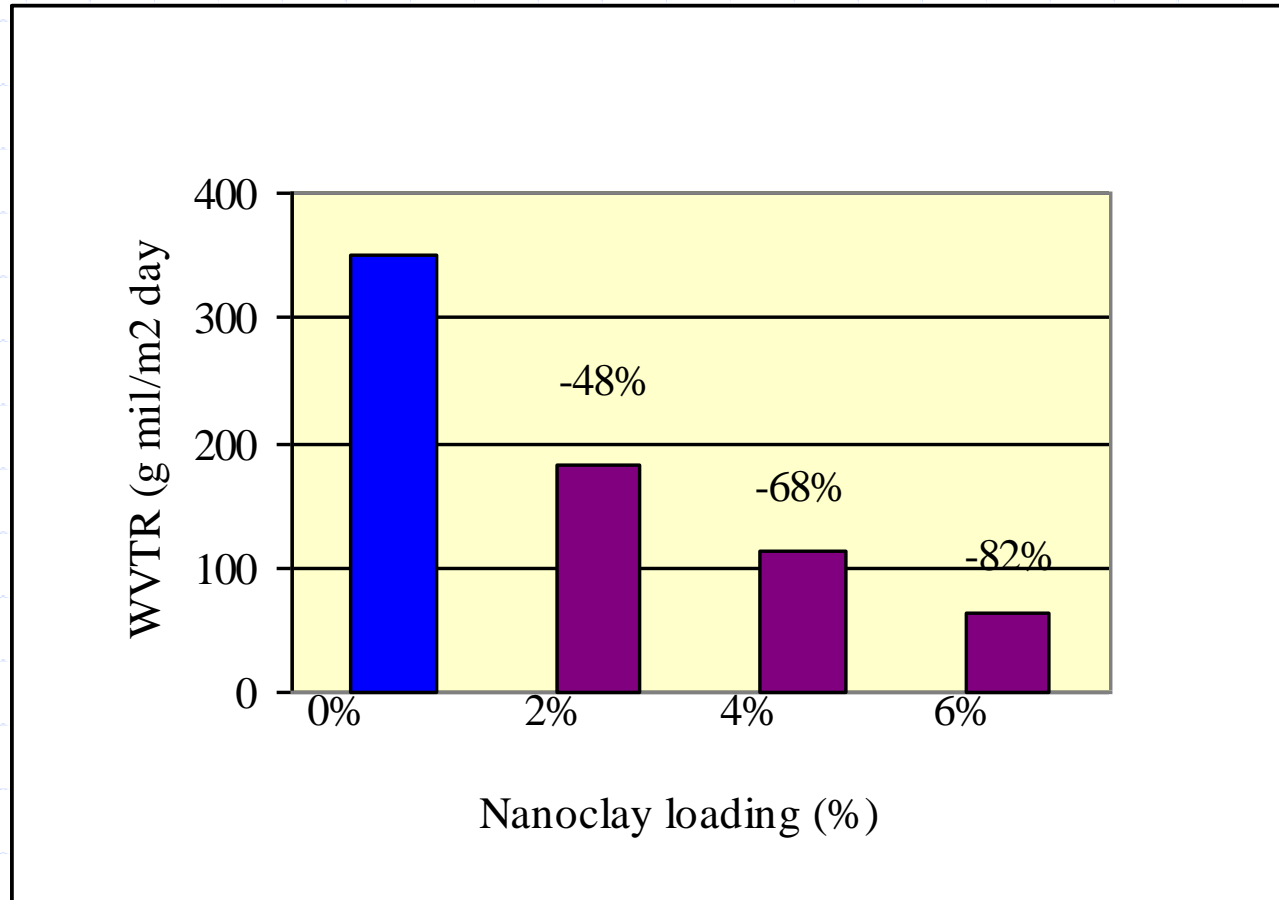


Nanoclay
layers

Nanoclay particles protruding from a plasma-etched polymer matrix

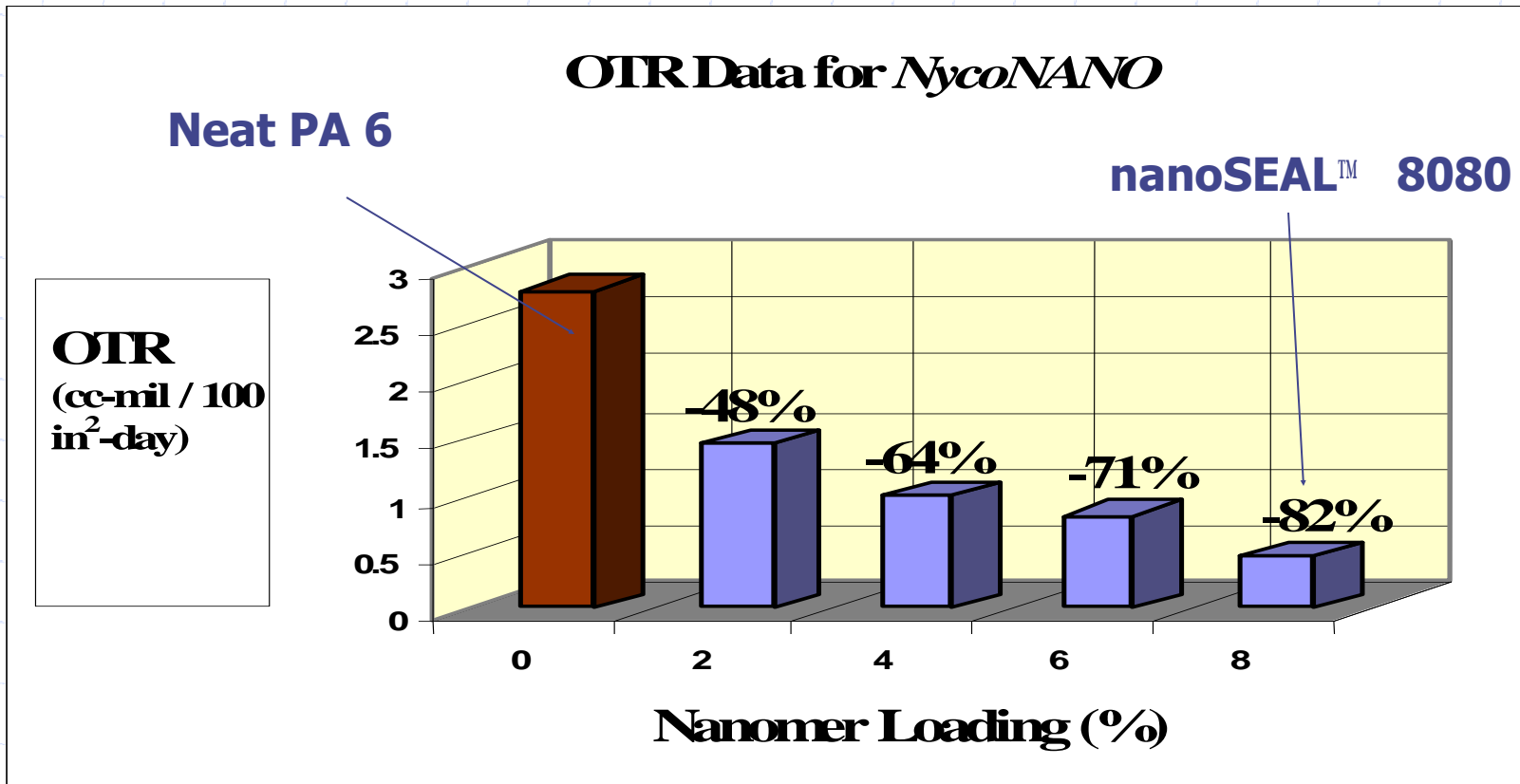
nanoSEAL™ *Barrier Properties*

Water Vapor Transmission Rate for nanoSEAL™



nanoSEAL™ *Barrier Properties*

Oxygen Transmission Rate for nanoSEAL™



PA6 nanocomposites *Typical Properties*

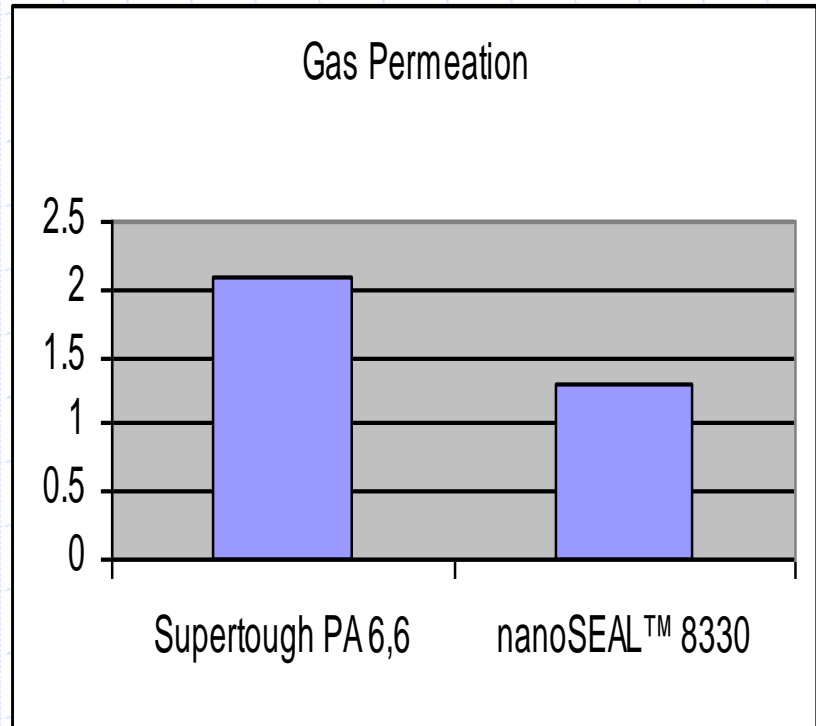
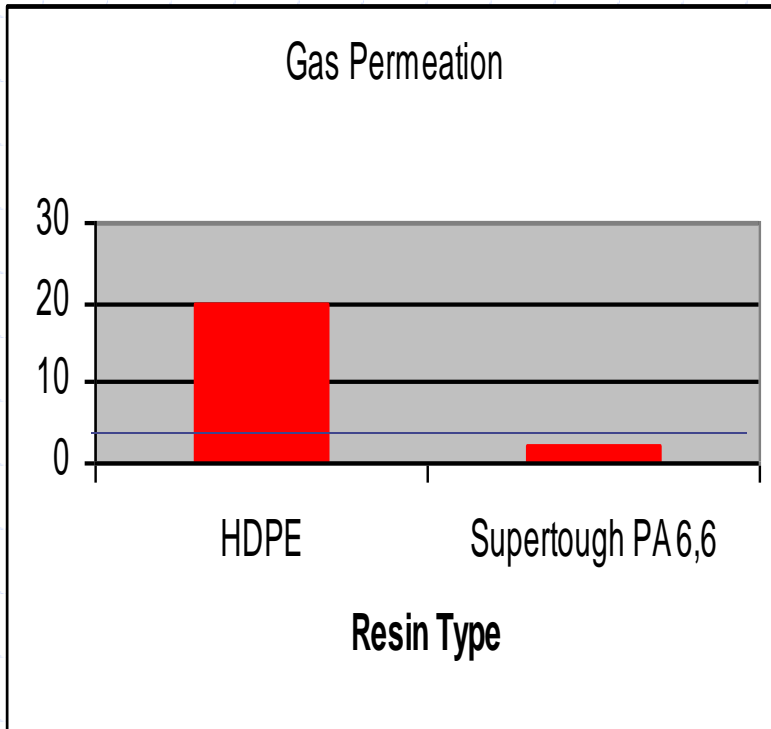
Nanomer Loading (wt. %)	Flex. Mod. (MPa)	Percentage Increase	Tensile Mod. (MPa)	Percentage Increase	HDT (°C)	Percentage Increase	Notched Izod Impact (ft LB/ in)
0	2836	-	2961	-	56	-	1
2	4326	53%	4403	49%	125	123%	0.6
4	4578	61%	4897	65%	131	134%	0.6
6	5388	90%	5875	98%	136	143%	0.6
8	6127	116%	6370	115%	154	175%	0.6

nanoSEAL™ *Properties*

Product	Tensile Strength (psi)	Flex Modulus (psi)	Notched Izod (ft.lbs/in)	Oxygen Permeation (cc-mil/100in²-day)	Gasoline Permeation (g-mm/m²-day)
Neat PA-6	13,000	400,000	1.0	2.6	1.1
Supertough PA 6,6	7,000	220,000	16	5.0	2.1
nanoSEAL 8330	8,700	320,000	16	3.0	1.3
nanoSEAL 8030	11,000	540,000	0.8	1.1	0.5
nanoSEAL 8080	8,000	770,000	0.5	0.4	0.2

Gasoline permeation Comparison

(g-mm/m²-day)



nanoSEAL™ 8330 has a 94% improvement in gas permeation over HDPE and a 40% improvement over Supertough nylon 6,6.

Time is Running Out To Meet CARB

First goes California then the rest of the country: EPA to follow suit

Don't be left behind!

CARB Timing Implementation:

2006 Fuel Hoses need to meet 15 g/m²-day

2007-2011 Fuel Tanks need to meet 2.5 g/m²-day for 80cc-225cc engines

In 2012 these tanks need to meet 1.5 g/m²-day

2008-2012 engines greater than 225 cc need to meet 2.5g/m²-day

In 2013 these tanks need to meet 1.5 g/m²-day

nanoSEAL™ is your CARB solution

nanoSEAL™ *Benefits*

Mono-layer solution (vs. multi layer and/or post treated (fluorination or sulfination) solutions)

- Low cost manufacturing process

- Eliminate logistical headaches and costs by eliminating post treatments

- Molder controls the solution

- Runs like a neat PA6 resin

Potential for weight reduction (down-gauge walls)

- Due to improved gas permeation

- Due to increased flex modulus over HDPE

Excellent cold weather impact properties (to -40° C)

nanoSEAL™ can be injection molded, extruded, or blow molded

Environmentally friendly: Clay is inert and **nanoSEAL™** is recyclable

UV, HS, and custom color formulations available



nanoSEAL™ *Your Low Cost CARB Solution*

Contact your Nycoa representative so they can demonstrate how to satisfy the permeation requirements and save money for your fuel tank and hose applications using **nanoSEAL™** .

Depending on your specific application, NYCOA can tailor a nylon polymer or compound to meet your design and/or process requirements.

Nycoa, the leader in-situ polymerized nylon nanocomposite technology and manufacturing.



For More Information on nanoSEAL™

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