

# Spray Painting with Nitrogen



An international patent of

**EUROSIDER**

# How the Nitotherm technology was born....

- The Italian company that developed and patented the technology and the equipment: Eurosider SAS di Ottavio Milli & C, Grosseto – Italy, has been dealing with gas separation since the '80s: from Oxygen for Hospitals to Carbon Dioxide for soft drinks to Nitrogen for Oil drilling or for wineries. The application for coating was the outcome of a fortunate finding!

# The Discover

- An Italian company located in Tuscany specialized in helmets for bikers production had big problems in coating the helmets for paint sagging issues and was offered a nitrogen generator for testing.
- All the issue of sagging disappeared immediately by using air enriched of nitrogen and it was also noted that in the warmest hours of the day the finishing was also better off than the early morning.....

The Nitrotherm technology took shape  
... it was the year 2003



# WHAT IS NITROGEN?

- Nitrogen is the chemical element that has the atomic number 7 (corresponding to the proton number contained in the atomic nucleus).
- Nitrogen is the fundamental constituent element of the most important organic molecules from a biochemical point of view (DNA, proteins, few vitamins), as well as of widely spread and very important inorganic components like ammonia and nitric acid.
- The molecular nitrogen ( $N_2$ , consisting of two nitrogen atoms) is a colorless, odorless, tasteless and inert gas constituting 78% by volume of Earth's atmosphere (is the most widely spread gas in the air).

# Production and supply of Nitrogen

Nitrogen, a widely used industrial gas, is produced in liquid and gaseous forms by means of:

A) cryogenic separation of air: compression and decompression of air until it liquefies. Using different boiling points, the components of air are separated in a distillation column.

B) P.S.A. (Pressure Swing Adsorption): generators having minimum two absorbers filled with molecular sieve (CMS). Compressed air, previously treated to eliminate oil, moisture and dust, is alternately passed through the absorbers producing nitrogen. While compressed air is passed through a container producing gas, the other one is regenerated by exhausting the gasses previously adsorbed at atmospheric pressure. The process is repeated in a cyclic manner.

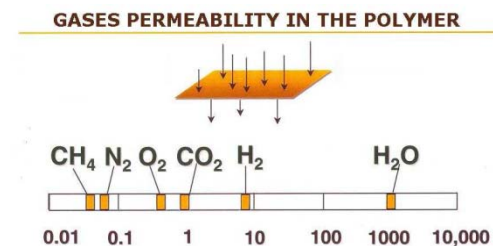
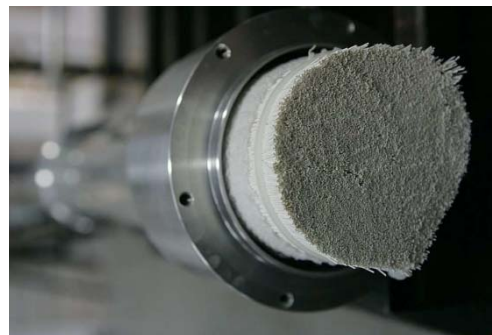
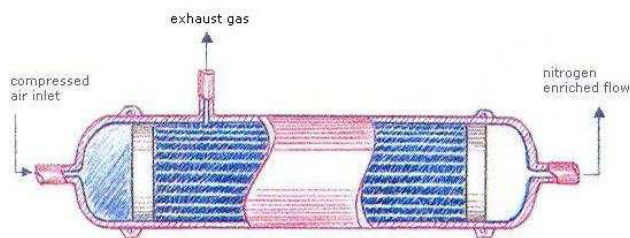
C) membrane separation: technology using the hollow fibers polymer membranes to separate the gaseous nitrogen from air using the selective permeation of the membrane.

# How the nitrogen enriched flow is obtained?

The composition of the atmospheric air: 78% nitrogen, 21% oxygen and 1% trace gases.

The polymeric membrane (“molecular discriminator”) of Nitrotherm uses 3 principles to separate the nitrogen enriched flow from the compressed air:

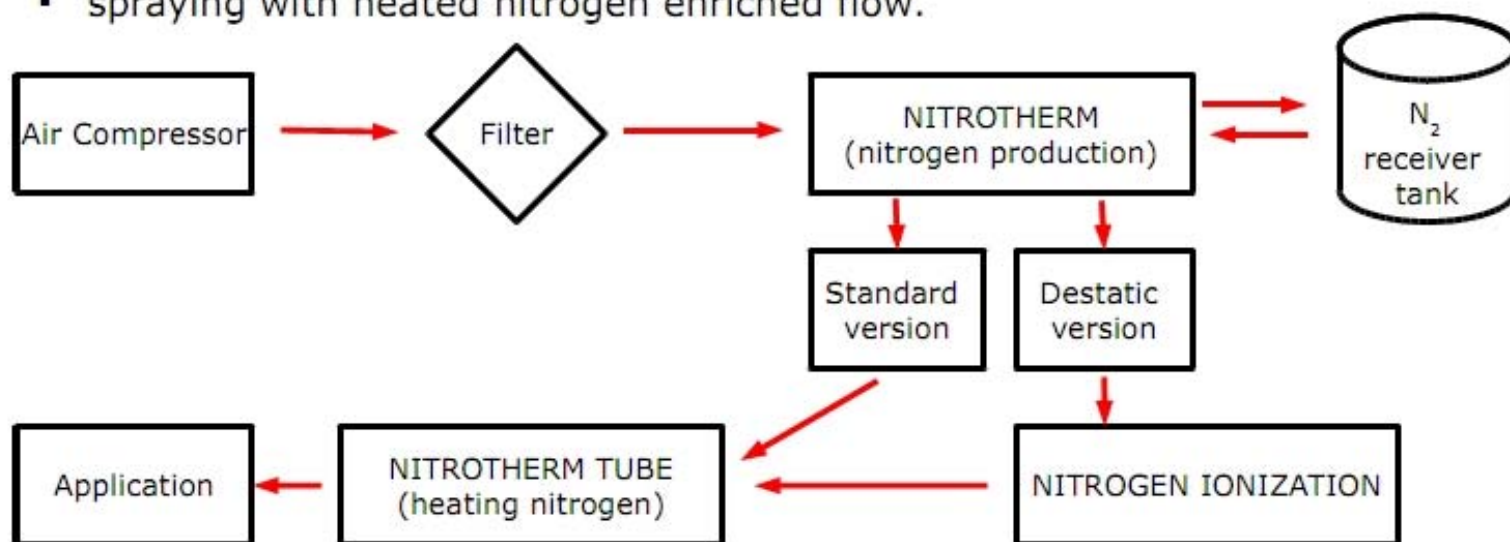
- hollow fibers, the most advantageous geometrical form for membrane processes (large density of filtering surface, low energy consumption);
- selective permeation: each gas has a characteristic permeation rate that is its ability to dissolve and diffuse through a membrane. It is therefore possible to separate gases such oxygen, helium, water vapor (permeated) from nitrogen, argon (concentrated);
- tangent flow: avoids the accumulation of permeated molecules, the membrane is not subject to progressive contamination since the exhaust gases are eliminated at atmospheric pressure.



## How nitrogen enriched flow is obtained?

The coating cycle using Nitrotherm consists of **7 operational principles**:

- compressed air supply (compressor + dryer);
- compressed air filtration;
- selective permeation (nitrogen enriched flow production);
- accumulation of the nitrogen enriched flow to be used in a receiver tank;
- positive or negative ionization of nitrogen enriched flow (with the DESTATIC option);
- heating of the nitrogen enriched flow using Nitrotherm Tube;
- spraying with heated nitrogen enriched flow.



Nitrotherm: heated nitrogen for coating

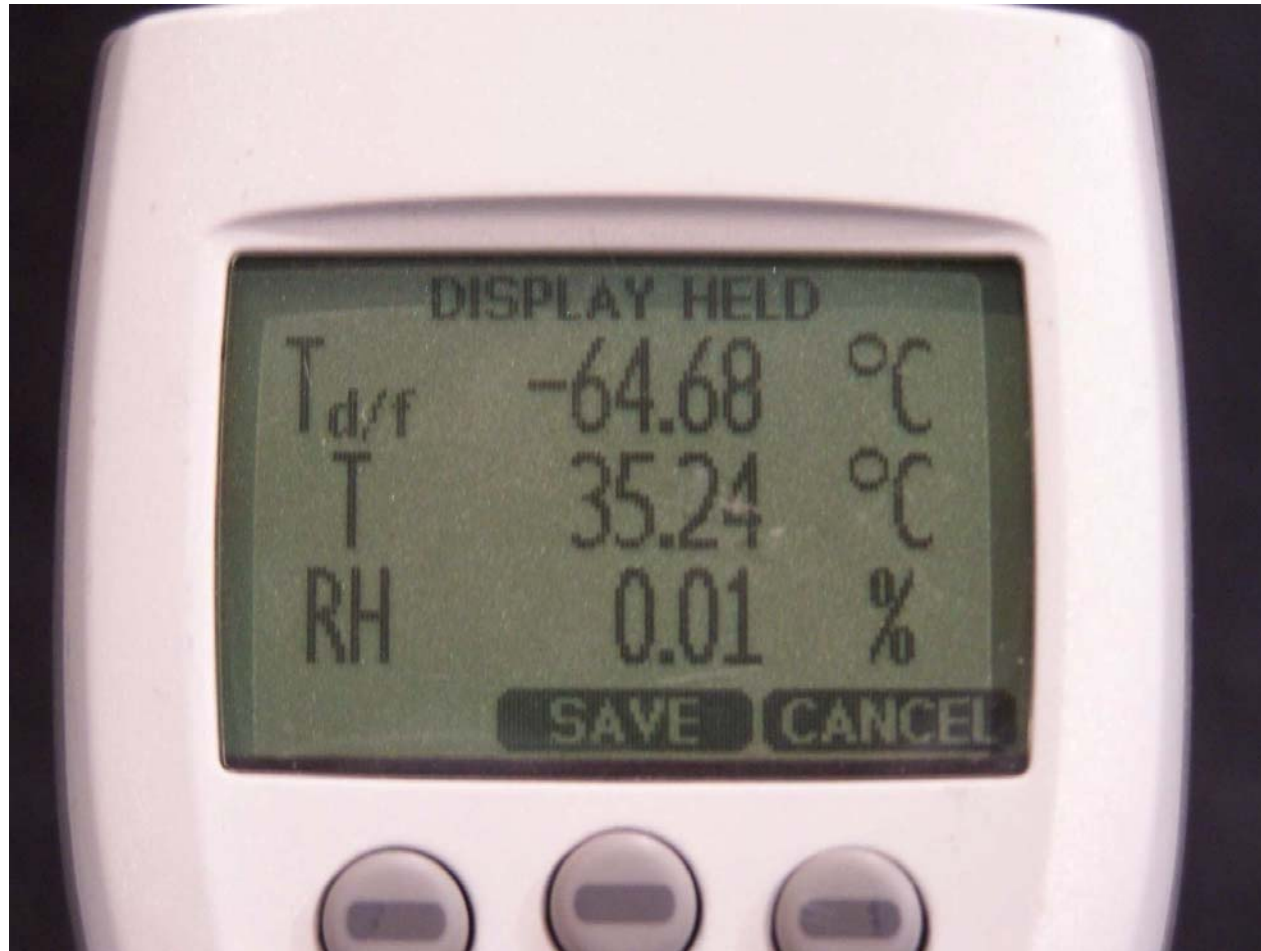




# Why Nitrotherm for coating?

- nitrogen is anhydrous and without impurities (dust, oil, fumes, chemical pollutants);
- nitrogen is an inert and stable gas;
- the paint particles are faster = less working pressure:
  - ✓ less overspray;
  - ✓ increased transfer efficiency on the surface;
  - ✓ better working environment conditions and less spray booth filter maintenance.
- heated nitrogen using Nitrotherm Tube:
  - ✓ lower product viscosity;
  - ✓ reduced use of solvents = no orange peel effect and no micro air bubbles;
  - ✓ reduction of volatile organic components (VOC);
  - ✓ improved application and transfer efficiency;
  - ✓ improved coverage and less aggressive product

# Nitrogen dew point

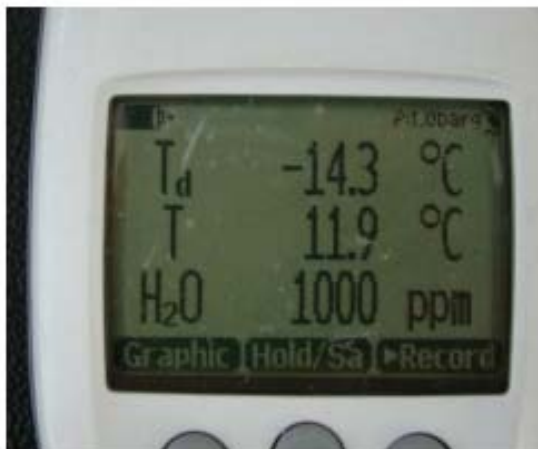


## Why use NITROTHERM to coat?

Using the VIASALA HM70 temperature and humidity device, we measured the dew point, the temperature and the humidity at 2 bar g pressure (29 psig) and the heating temperature set at 60° C (140° F).



**Compressed air**



**Heated compressed air**



**Heated nitrogen**



Nitrotherm: heated nitrogen for coating



## Why Nitrotherm for coating?

- it is possible to charge the enriched flow of nitrogen with positive or negative ions and regulate the polarity of the cone
- charge quantity (up to 15 kV).
- Notice: NITROTHERM does not replace electrostatic applications nor does it permanently solve problems caused by static charges. The DESTATIC version (which includes an ionizer) makes the work easier either during application (metallic products) or at the end of the process (drastic reduction of impurities on the target).

# Electrostatic charge



# Droplets velocity comparison

PNR Italia Srl, a company successfully manufacturing industrial atomizers and supplying liquid atomization based systems since 1968, studied and compared the cone produced with compressed air and nitrogen with a **Laser Test**. An air assisted spray gun was used, sprayed pressure at 1 bar g (14.5 psi g).

## COMPRESSED AIR

	Channel 1	Channel 2	Channel 3
Velocity Mean (m/sec)	7.2452	0.0000	0.0000
Velocity RMS (m/sec)	3.1451	0.0000	0.0000
Turbulence Intensity (%)	43.41	0.00	0.00
Frequency Mean (MHz)	5.1257	0.0000	0.0000
Frequency RMS (MHz)	0.4886	0.0000	0.0000
Frequency TI (%)	9.53	0.00	0.00
Gate Time Mean (usec)	10.71	0.00	0.00
Gate Time RMS (usec)	10.64	0.00	0.00
Data Rate (Hz)	9033	0	0
Valid Count	5000	0	0
Invalid Count	0	0	0
Elapsed Time (sec)	0.8304		

## NITROGEN

	Channel 1	Channel 2	Channel 3
Velocity Mean (m/sec)	13.1753	0.0000	0.0000
Velocity RMS (m/sec)	4.7149	0.0000	0.0000
Turbulence Intensity (%)	35.79	0.00	0.00
Frequency Mean (MHz)	6.0470	0.0000	0.0000
Frequency RMS (MHz)	0.7325	0.0000	0.0000
Frequency TI (%)	12.11	0.00	0.00
Gate Time Mean (usec)	6.08	0.00	0.00
Gate Time RMS (usec)	4.58	0.00	0.00
Data Rate (Hz)	5530	0	0
Valid Count	5000	0	0
Invalid Count	0	0	0
Elapsed Time (sec)	1.3566		

# Droplets diameter comparison

**D10** = medium diameter, **D20** = medium surface, **D30** = medium volume, **D32** = volume/area (low values = better evaporation on surface and better atomization of sprayed products).

## COMPRESSED AIR

		PVC	Spatial
D10 (um)	32.91	27.95	26.08
D20 (um)	36.94	32.87	30.71
D30 (um)	40.93	37.30	34.88
D32 (um)	50.24	48.02	44.98
D43 (um)	60.04	57.78	
Size Data Rate (Hz)	9019		
Size Valid Count	5000		
Epsilon Exception	149		
Diameter Exception	363		
Intensity Invalid	988		

## NITROGEN

		PVC	Spatial
D10 (um)	29.73	28.18	27.40
D20 (um)	32.48	31.21	30.42
D30 (um)	35.01	33.89	33.07
D32 (um)	40.68	39.94	39.09
D43 (um)	46.30	45.50	
Size Data Rate (Hz)	5521		
Size Valid Count	5000		
Epsilon Exception	177		
Diameter Exception	431		
Intensity Invalid	319		

# Heated Polarized Nitrogen

- Greater transfer efficiency (fewer coats for the same dry mils)
- Reduction of process time with wet on wet applications (fewer trips around the object).
- Less solvents (reduced flash time, possible shorter Bake Cycles)
- Paint is better distended on the target, resulting in better Distinction Of Image (DOI) and Higher Quality.
- Less Contamination = Less Sanding and Buffing.
- Less material usage with better coverage.
- Less Filter Load.
- Reduced time in booth.
- Greater productivity.
- Less VOC Produced



# Typical installation



# Nitrotherm expansion

2003: The Nitrotherm units were designed and begun to be sold in Italy;

2004: Significant expansion to the Woodworking Sector – North East of Italy, and approach to the automotive aftermarket nationwide

2005: With Autopromotec Bologna Eurosider started distributing the technology in Europe and North America

2006-2009: New Sectors of activity were found: from Marine (boats, yachts) to Railway coaches manufacturing Industries to Spectacles manufacturers, to Aviation Industry and so on. Eurosider expands the activity in Asia.

2010-2014: The Nitrotherm becomes a world wide technology thanks to a network of distributors that covers mostly of the world. In 2010 eventually an important breakthrough in the Automotive OEM Car manufacturing in North America that, event that starts a new era in the technology diffusion to the current days.

# Transition from Compressed air to Nitrogen

The Nitrotherm technology is not Plug & Play, meaning that by replacing the fluid carrier from compressed air to air enriched of nitrogen some adaptations MUST be carried out.

The Nitrotherm does not conflict with any brand of equipment or paint used for coating by the end users.

Spraying Pressures surely need to be reduced and most of the times also the nozzle sets need to be replaced to a lower tip diameter

A new technique of spraying, more visual than auditive, is normally learned easily in a few hours of training (distance of the gun from the target, fan pattern, overlaps, speed of the hand of robotized strokes with the sprayguns/nozzles

Polarity of the spray cone setting: +/-

# Evolution of the Nitrotherm technology for Robotized and electrostatic coating

We can announce that we have several new pieces of equipment and add on features to implement the Nitrotherm Technology and that are, all of them, under separate patented claims worldwide:

Add on Features:

- a) Pulsair®: a system for pulsating the ions of the nitrogen enriched fluid carrier in the cone/plume to allow a better reach of the paint droplets in difficult parts of the target
- b) Thermocoat®: a system for keeping the temperature of the paint constant during the coating process
- c) NitroRobot®: a whole system encompassing all the Eurosider patented technologies designed expressly for Electrostatic Coating (Rotary Bells)
- d) Polifluid®: a system for powder coating

# Contacts and References

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