CRYOGENIC PAINT REMOVING

1) The project: description

There is plenty of industrial activities, that include different kinds of painting steps for a wide range of products. According to a recent esteem, in Italy there are around 150 firms using painting processes on various materials, while in the whole Europe there are more than 500,000 firms. All these firms have a common problem that is the accumulation of deposits on the conveying lines of the parts to be painted, since 35-40% of the sprayed paint settle on such systems. The paint accumulated on hooks and frames leads to quality problems, and therefore to more wastes and higher paint consumption. As a consequence, the mechanical parts building up the anchoring and conveying systems of the parts to be painted (frames, hooks, racks), need to be stripped.

Inadequate solutions that do not carry about the problems linked to paint-stripping, not only slow the production and lower the quality, but can also have dangerous consequences on the ecological situation because of fumes, powders, organic or chlorinated solvents, acids.

The present project is based on the Cryogenic Technology, that is on the capability of the cryogenic fluids, such as liquid Nitrogen - Argon - carbon dioxide to reach very low temperatures making the paint deposits on the supports fragile, and their removal, therefore, easier.

The basic concept is simple: the support covered with paint is plunged into a fluid with a low temperature which quickly cools it, lowering the volume of the paint. The paint suddenly shrinks since it directly gets in touch with the liquid gas, while the support, which is insulated by the paint, undergoes the effect of cold only later and only a non-significant shrinkage. As a consequence, the paint that is shrinking is hindered by the metallic support, because of their different shrinkage velocities, cracks and separates from the support. In order to get the perfect removal a slight mechanical action is required at last.

Let's have a detailed look at the basic steps of the cryogenic process.

When the supports to be stripped are plunged into the cryogenic fluid, a significant evaporation of the fluid takes place (as when an incandescent metall is plunged into water), followed by loud chattering because of the thermal shock to which the support itself is subject; as a consequence the settled paint begins to crack and fissure.

Such a phenomenon takes places for about 30", as boiling due to the high temperature differential (Æ T°) between the paint coat and the metallic part.

The whole action takes 1-2 minutes and it is inversely proportional to the thickness of the coat and directly proportional to the coefficient of thermal conductivity (K).

From the point of view of consumption of the cryogenic fluid, the expected values are about 0,7± 0,9 lt. N2L per Kg. of treated product, including the leaks due to natural evaporation.

Although with different periods of time, all the kinds of paint should become brittle, both powder and liquid paints, and with different basic resins such as: epoxy, epoxy-polyester, polyurethanic, polyester, acrilic resin and so on. Also the different ways of painting will be evaluated: electrostatic painting, electrocoating, airless, dipping or fluid bed painting. The cohesion paint-support always becomes weaker and it is directly proportional to the temperature reached by the painted part; the more it tends to the temperature of the cryogenic fluid, the more it becomes brittle and the easier it is to remove the paint.

Very important is the coefficient of thermal conductivity (K); that's why porous structures with high K require testing in order to test the lower cracking and therefore the longer dipping time needed to make the paint brittle. This takes place above all with those painting products with high mineral extenders, such as calcium, barium carbonate, silicon dioxide, etc.

The coat of paint is easier to be removed if the metallic surface has been previously treated with a slight detaching layer with water base which lowers the cohesion between the sprayed paint and the support.

The different steps of the operating cycle can be summed up as follows:

a) The support is plunged into a tank full of cryogenic fluid: as a consequence the coat of paint becomes brittle and cracks.

b)The paint is mechanically removed by a shotblasting machine: the scales of paint will therefore be wholly detached and then collected into the specially provided containers.

c) The water based detaching agent is applied in order to protect the support and to make the next paint removal easier.

d) Drying of the treated support.

The project is aimed at working out a system on industrial basis to optimize costs and time for the paint removal, using the cryogenic technology on various metallic supports, covered with the different kinds of paints present on the market, with its important enviroment-friendly feature since it does not pollute with fumes, powders, solvents, acids.

2) Expected results

From the industrial point of view the expected results confirm the cryogenic technology as a "clean" alternative to the normally used techniques, such as:

- thermal paint removing
- chemical paint removing
- mechanical paint removing.

The economic levels of the cryogenic process, analysed in section 7), make us think that: much money can be saved from the cost per Kg. of treated material.

From the point of view of safety on the workplace, the cryogenic process wholly meets all the requirements of the simplest safety regulations, since no dangerous substances are either used or produced such as: organic solvents - decomposition acids or fumes. The cryogenic process is above all based on fluids, like liquid nitrogen, that are not toxic - not inflammable - not corrosive and physiologically inert.

From the point of view of *environmental protection*, the cryogenic process stands out among the traditional paint removing methods, because it does not require that series of "steam-damp" methods, for example for the fumes released into the atmosphere or to discharge solvents and acids when either the thermal or the chemical methods are used.

The waste of the cryogenic paint removing are simple, paint scales. According to the ecological Italian regulation, such residuals of polymerized thermosetting or thermoplastic resins are to be considered as special, solid waste.

The cryogenic technology virtually enables the user of the system not to invest in special protection systems to prevent deleterious substances from being released into the atmosphere.

3) Interest of the European Community in the Project

The interest of the European Community in Cryogenic Paint Removing is due to the fact that in Europe, the industry for the production of paint employs more than 100,000 people, 13,250 of which are in Italy.

Taking into consideration the quantity of paint produced in Europe, it is about 6,900-7,200 tons per year. If we think that even only 30% of the whole quantity has to be removed from the supports in the traditional ways, and therefore with great danger for the environmental ecological system, it's easy to understand how important it becomes, to work out a new technology matching the economic interest with the protection of the environment. The environmental regulations prescribe nowadays the use of special ways that would either damp fumes or purify waste water from pollutants.

All this requires recurrent maintenance to be serviceable, which means great financial involvement in investments and resources without the complete prevention.

M.E.C. believes, that once shown that the cryogenic technology can be applied to industry as paint removing technology, the interest of European companies belonging to the European community can be turned into industrial co-operation giving a great impulse to Cryogenics.

Here are some data concerning industry: Germany produces around 1,550 tons of paint per year, France around 750, Italy around 700, Great Britain 650, Belgium around 180.

4) An Innovative Project

From the industrial point of view, paint removing is erroneously seen as a process without any profit, and therefore to be carried out only when the supports are so covered with paint to totally endanger the output of painted details.

Such way of thinking leads to improvised solution to remove the paint, which are in most of the cases not proper, dangerous and with poor results.

Using either the thermal or the chemical method means continuous care because of the different formulae of the paints in order to properly set the instruments for the thermal process, while the solvent in the tanks might have to be replaced by a more proper one in the case of the chemical process.