CLEANING AND PRE-TREATMENT IN ONE STEP AT ROOM TEMPERATURE
Sgrassaggio e pre-trattamento mono stadio a freddo

Carlo Guidetti
Chemtec S.r.l., Ossona (MI),
Italy

History
The one step technology for cleaning and phosphating metal surfaces at room temperature, before painting, also known as PAI-KOR PLAFORIZATION® process, was invented at the end of the 1960s.
The first generation of product contained chlorinated solvents and it had success in Italy in the 1970s and then in the 1980s, also in some European markets.
The requirements of the European and international laws that rule industrial practices, and the emission of solvents to the atmosphere and, at the same time, the constant increase of the market’s quality requirements, pushed the formulators to a constant update and improvement of this technology. In this way chlorinated solvents were replaced at first by aromatic and aliphatic solvents, then by other organic fluids chosen because of their high boiling point, high flash point, not classified as VOC, not toxic, not harmful. At the same time, a big effort has been done to improve the quality of mechanical properties and of corrosion resistance provided by this technology in combination with the top coating available on the markets. The new products recently developed are currently used in about 500 industrial plants mainly in several European and North American markets as well as in Turkey, Mexico and South America.

Storia
La tecnologia per lo sgrassaggio e la fosfatazione organica mono stadio a freddo delle superfici metalliche alla verniciatura, nota come processo PAI-KOR PLAFORIZZAZIONE®, fu inventata sul finire degli anni ’60. La prima generazione di prodotti conteneva solventi clorurati ed ebbe un discreto successo in Italia negli anni ’70 e quindi negli anni ’80 in alcuni mercati europei.
L’attenzione alle normative europee ed internazionali che regolano gli utilizzi e le emissioni di solventi in atmosfera, e parallelamente, le sempre crescenti esigenze qualitative degli utilizzatori, hanno spinto i formulatori ad un costante aggiornamento e miglioramento della tecnologia.
Ciò ha comportato la sostituzione dei solventi clorurati dapprima con solventi aromatici ed alifatici, quindi con particolari fluidi organici alto-bollenti, non infiammabili, non classificati come COV, non tossici né nocivi. Parallelamente un grande lavoro è stato eseguito per migliorare la qualità delle resistenze meccaniche delle finiture e di resistenza alla corrosione fornite da questa tecnologia in combinazione con le svariate finiture presenti sui mercati.
I nuovi prodotti sviluppati sono al momento utilizzati in circa 500 impianti industriali principalmente in diversi mercati Europei e Nord Americani, ma anche in Turchia, Messico e Sud America.
Last September 2010 Chemtec S.r.l. acquired the exclusive right to use these formulations and the relative brands and is going to launch on the Italian and international markets these unique and advanced products.

Process Basics
The PLAFORIZATION® ECOPHOR process contains a set of particular organic fluids with high boiling points and a specific blend of polymer modified with phosphate groups (organic polyphosphate).

The process works in one stage, with no preliminary degreasing and no rinsing. Treatment time is about 60 – 120 seconds at room temperature, followed by 5 minutes of draining off then drying off in an oven for 8 – 10 minutes at 130 – 150°C. Application may be by dip or spray coat, at ambient temperature during which several different processes occur almost simultaneously:
1. Oily contaminants are dissolved by the organic fluids while solid particles are washed off
2. The metal surface is attacked by the phosphate groups in the organic resin
3. During fluid flash-off, the organic polymeric resins cross-link by creating a uniform organic coating with a thickness of about one micron.

This organic polymer provides excellent resistance against flash rust (Fig. 1) and also provides excellent adhesion with topcoats (either powder coating or wet paint) on steel as well as on non ferrous metals. During fluid flash-off, the oily contaminants dissolved in the product are captured by the three-dimensional structure of the organic polymer without interfering in the interaction between the polymer itself and the topcoat. In fact, rather than being a waste product, the oils become a useful part of the process. As the product is used in the pretreatment, new fresh product is added to “top up” the level of chemical in the tank. This, of course, also adds “fresh organic resin” to the bath. So, on a continuous basis, the system is capable of absorbing up to 1.5 grams of oil per square meter of metal surface treated, a value at least three times larger than the standard quantity of oil on cold-rolled steel normally available in the market.

Practically, for most customers, this limit is never reached. The insoluble solid particles are filtered out by a specific filtering system that is part of the equipment.
Cleaning and Pre-Treatment in One Step at Room Temperature

Technical Advantages
The ECOPHOR® process for metal surface pre-treatment prior to painting can guarantee the following advantages:
1. One step process, without any rinsing or preliminary degreasing
2. It works at ambient temperature
3. No sludge creation
4. No water is used
5. Very low CO2 and solvent emission
6. Multi-metal process (the same chemical will treat steel, aluminium and galvanized steel, separately or together)
7. The chemical used never needs to be disposed of
8. Safety in the working area: the chemical used is not toxic, harmful or flammable
9. Great flash-rust protection
10. No daily analysis.

Brand New
In 2009 a brand new process, called TORAN 3®, has been launched. TORAN 3® has all the same features and provides the same advantages as the ECOPHOR® system; additionally it provides a significant increase of corrosion resistance (Fig. 2) on steel as well as adhesion on non ferrous metals (Fig. 3). TORAN 3® contains the same organic fluid used in the ECOPHOR® process but has a set of resins which are different from a chemical point of view, with no phosphating groups: TORAN 3® is actually an organic passivation process.

I vantaggi tecnici
Il processo ECOPHOR® per la preparazione delle superfici metalliche alla verniciatura garantisce i seguenti vantaggi.
1. processo mono stadio, senza risciacquo e senza sgrassaggio preliminare
2. lavora a temperatura ambiente
3. nessuna creazione di reflui, fanghi, scarichi o morchie di reazione
4. nessun utilizzo di acqua
5. ridottissime emissioni di CO2 e di solventi
6. sistema “multi metal” (lo stesso prodotto può trattare ferro, alluminio e lamiera zinacata)
7. il prodotto non deve mai essere smaltito
8. elevata sicurezza nell’ambiente di lavoro: prodotti né tossici né nocivi né infiammabili
9. eccellente protezione temporanea
10. nessuna analisi quotidiana.

Ultime novità
Nel 2009 è stato lanciato un nuovo processo, denominato TORAN 3® che aggiunge alle caratteristiche ed ai vantaggi del sistema ECOPHOR®, un incremento significativo delle tenute alla corrosione (Fig. 2) su ferro e dell’adesione delle finiture su superfici non ferrose (Fig. 3).
Il sistema TORAN 3® si basa sugli stessi particolari fluidi organici del sistema ECOPHOR® e contiene polimeri chimicamente differenti, che non contengono gruppi fosfatici: il TORAN 3® è una passivazione organica.

Salt spray tests (ASTM B-117) carried out on cold rolled steel with different pre-treatments using the same TGIC free pure polyester powder coating.

Test di nebbia salina (ASTM B-117) eseguiti su acciaio laminato a freddo con pretrattamento diverso e rivestiti con polvere poliestere priva di TGIC.

Corrosion Resistance Chart

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On steel it is possible to get 400 hours of salt spray resistance (ISO 9227) (Fig. 4) with TGIC Free polyester powder coating while with those containing TGIC it is possible to reach up to 1,000 hours. At the moment there are about 15 users of TORAN 3® in Europe; some of them used to use ECOPHOR® and switched to TORAN 3® for the above mentioned advantages.

Environmental Respect
Neither TORAN 3® nor ECOPHOR® creates any waste to be disposed of, nor any metals or surfactants or any substances which may pollute the ground or water. Therefore the use of these technologies allows the metal finishing industry to eliminate any pollution to water or ground. These processes work at ambient temperature so energy consumption is reduced to a minimum. TORAN 3® and

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Tests carried out by an independent laboratory in France on cold rolled steel and aluminium samples treated by different pre-treatments with polyester TGIC free powder coating.

Prove eseguite da un laboratorio indipendente in Francia su campioni in acciaio laminato a freddo e alluminio trattati con pretrattamenti diversi e rivestiti con polveri poliestere prive di TGIC.

An example of two metal sheets after salt spray after 400 hours (ASTM B-117), in cold rolled steel with polyester TGIC free powder coating; one metal sheet has been pre-treated with ECOPHOR® PLAFORIZATION® system, the other with new TORAN 3® process.

Un esempio di due lamierini sottoposti a prove di nebbia salina per 400 ore (ASTM B-117), in acciaio laminato a freddo con vernici poliestere senza TGIC; un lamierino è stato pre-trattato con ECOPHOR® PLAFORIZZAZIONE®, l’altro col nuovo processo TORAN 3®

Garantisce all’industria della verniciatura di non creare alcun inquinamento per le acque e per i terreni. Questi processi non devono essere scaldata, quindi i consumi energetici sono ridotti al minimo. I sistemi ECOPHOR® e
Cleaning and Pre-Treatment in One Step at Room Temperature

ECOPHOR® systems are not classified as VOC as defined by European law: the fluids used have such a low vapour pressure that the product can be recovered and re-used, reducing to a minimum the evaporation of the chemical during its use.

In the drying off oven, the very low thermal stability of the fluids used dramatically reduces emission to the atmosphere and, thanks to the high percentage of Oxygen contained in these fluids, the quantity of CO₂ created is very low.

**Economical Advantages**

The use of one-step technology for cleaning and pre-treatment of metal, prior to painting allows (Fig. 5):

- A significant reduction in capital investment for the equipment (about 40-50% less)
- Saving of space
- Elimination of the typical costs for the conventional water based process such as: heating up the chemicals, electrical energy to pump large volumes of chemicals in many tanks, waste water treatment, equipment maintenance, analysis, etc.
- Highest process efficiency, since there is no waste of time in production (to control the chemical make up of the liquid or to wait until the chemicals have reached the right temperature).

On the other side, the cost of the chemicals has a more significant impact in comparison with conventional water based process.

The economical balance is normally favourable for ECOPHOR® and TORAN 3® for plants that treat less than 1,500 m² in a day. For large painting lines that treat more than 2,500 m² in a day it is possible to use a scrubber to recover the organic fluid and dramatically reduce the process cost.

**Conclusion**

The one-step ambient temperature processes for organic phosphating, ECOPHOR® or organic passivation, TORAN 3® represent a big innovation for the metal finishing industry, as an alternative to iron

TORAN 3® non sono classificati come COV ai sensi delle vigenti normative europee: la bassissima tensione di vapore consente il recupero ed il re-utilizzo del prodotto contenendo le perdite per evaporazione. Nella fase di essiccazione, la bassa stabilità termica dei fluidi organici utilizzati fa sì che le emissioni in atmosfera siano molto basse e che, grazie all’elevata quantità di ossigeno contenuta in questi fluidi, la quantità di CO₂ creata sia ridottissima.

**I vantaggi economici**

L’utilizzo di tecnologie monostadio per lo sgrassaggio ed il pre-trattamento dei metalli alla verniciatura consente (fig. 5):

- una drastica riduzione dell’investimento iniziale per l’impianto (circa il 40-50% in meno)
- riduzione dello spazio occupato
- azzeramento di costi tipici dei sistemi tradizionali di pretrattamento quali: riscaldamento del prodotto, energia elettrica, trattamento acque reflue e scarichi, manutenzioni, analisi, ecc.
- massima efficienza di processo per l’assenza di tempi morti (per le analisi di controllo o per attendere che il liquido raggiunga la temperatura di esercizio).

Al contrario, il costo del prodotto chimico ha un maggiore impatto rispetto ai tradizionali processi a base acqua.

Il bilancio economico è favorevole per i processi ECOPHOR® e TORAN 3® per impianti che trattano meno di circa 1.500 m² al giorno. Per grandi linee di verniciatura che trattano più di 2.500 m² al giorno è possibile utilizzare uno scrubber per il recupero dei fluidi organici e abbattere drasticamente i costi di processo.

**Conclusioni**

I processi mono stadio a freddo per la fosfatazione organica ECOPHOR® e la passivazione organica TORAN 3® rappresentano una grande innovazione per l’industria della preparazione delle superfici alla verniciatura, proponendosi come alternative re-
phosphate; and also to iron phosphate followed by sealing; and in some cases, also to zinc phosphate. These processes allow great mechanical properties (flexibility and adhesion) of the topcoat as well as excellent flash-rust and corrosion resistance and a great simplicity in the daily use in order to meet market’s growing quality and environmental requirements.

The reduction of the capital investment, the elimination of the variable costs of conventional water based processes and labour, necessary for the maintenance of these systems, together with the very high process efficiency allows ECOPHOR® and TORAN 3® to be more convenient and more economical for a wide variety of industries.

At the same time, environmental respect is guaranteed by the very low energy consumption, the elimination of discharge, the saving of water and very low CO₂ emission and by the use of products not classified as VOC material.