Concrete surface treatment

"Skin-care" for high quality Manufactured Concrete Products

Paving stones, slabs and other Manufactured Concrete Products (MCP) are the selected solution for many indoor and outdoor applications, both in residential, non-residential and infrastructural areas. Besides their primary functionality, which is to act as a floor and bear the specific loads required for each use destination, these elements are chosen also for their beauty, as they are actually expected to bring a contribution to the aesthetics of the environment. In past years, pavers and slabs were considered basic products; nowadays, a variety of shapes, colors and surface effects are available and we have witnessed a remarkable diversification, so that it is possible to find in the market also sophisticated elements with high added value. A wide range of possibilities is actually available to the contractor and the end user, and aesthetics is usually the distinctive and key buying criterion.

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When referring to aesthetics, we mean not only the initial characteristics of the products like their color and surface texture, that are offered by the producer and selected by the buyer according to his/her taste, but also to the capability of maintaining their initial beauty as intact as possible over the time. This is particularly important when pavers and slabs are placed in areas, like outdoor restaurants, where they are susceptible to soiling by different types of dirt: oil, wine, mayonnaise etc. Parking places are another example, where paving stones are often used and exposed to the attack of car oil during their lifecycle: already after a short timeframe, the stains of oil typically appear on the surface, with a very undesirable effect.

Fact is that, due to the porous nature of their surface, unless protected, the elements can absorb the dirt, which then penetrates in the substrate, becoming afterwards difficult to remove through the normal operations of cleaning with hydro-jetting machines. As a result, the pavers show remarkable and undesired signs of dirt, which inevitably compromise their beauty.

Efflorescence, i.e. the formation of a thin layer of calcium carbonate on the surface, is also a deleterious phenomenon for the aesthetics of dry-consistency concrete elements; its occurrence can be minimized by means of water-repellent chemical admixtures that are added to the concrete mix, at dosage between 0.4% and 1.5% of cement content. The widespread solution offered by BASF Master Builders Solutions is represented by MasterPel integral admixtures, whose mechanism of action is based on the formation of stable chemical bonds with the silicon of the cement and fine sand particles. This inhibits the migration of water and the consequent transportation of calcium hydroxide to the surface, which would then react with carbon dioxide to form the whitish deposit known as efflorescence.

These water repellent and anti-efflorescence admixtures do also partially hinder the adhesion and penetration of dirt from the surface, but such effect is limited and cannot be referred to as a real protection against the specific types of soiling agents that can, depending on the use destination, attack the surface and become responsible for deleterious effects on the aspect of the floor.

To achieve this additional anti-soiling property, several types of protecting agents are proposed in the market and it is sometimes rather difficult to understand the difference among them, as well as the specific working mechanism and durability of each. As a common characteristic, they normally consider the surface as the only part responsible for the aesthetics of the pavers and slabs, and therefore basically cover it with an artificial layer, quite often altering its original texture and color.

Based on this background, the Technical Experts of BASF Master Builders Solutions have been investigating the concept of protection for Manufactured Concrete Products, taking a new perspective: concrete is a living material and the surface is only the skin; protection should take into consideration the whole element. As it is normally the case for human beings, the skin is the external expression and evidence for the internal wellness and health of the body underneath.

As a result, a new solution has been developed, which is based on a combination of three approaches:

- MasterCast in the concrete bottom layer, to ensure optimal compactability and fillability of the concrete, as well as for the optimization of the concrete mix with potential to reduce the clinker content;
- MasterPel concrete admixture, to be dosed in the concrete mixes for both bottom and top layer. It protects the body of the concrete element by hindering all mechanisms of transportation of water and salts within the concrete pore system.
- MasterPel 500, a newly designed protecting agent, to be spray-applied on the surface of the fresh elements, which will be described more extensively in this article.

MasterPel 500 is an impregnation agent suitable for paving stones and any other type of Manufactured Concrete products, i.e. elements made with dry or semi-dry concrete and vibro-compacted by simple vibration or vibro-compression.

MasterPel 500 provides superior aesthetics and protection of the surface against water, oil and different types of dirt: oils, ketchup, mayonnaise, wine, coffee etc. The dirt has very limited adhesion to the surface and therefore does not penetrate inside the element, even if it remains for several hours on the surface. After severe dirt attack, the elements can be cleaned easily with normal hydrojet cleaning machines and the dirt stains removed.

Herewith, the development stages of this new Solution are described, from the identification of test methods, to product development and optimization, up to industrial applications.

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The Process Efficiency Method (PEM), developed by BASF, allows the lab simulation of the industrial production process for paving stones and vibro-compacted elements in general. This equipment permits the preparation of monolayer and double layers elements and is widely used for the development and testing of admixtures. It is a key tool for the identification of tailor-made solutions for customers, addressing the 4 Elements that are highly valued by MCP Manufacturers

- Economy
- Performance
- Aesthetics
- Durability

The specimens shaped and compacted through the PEM method show a surface texture that resembles the one of real industrial paving stones, therefore they could be used for the evaluation and development of products for surface treatment in the lab. This approach was adopted to run a complete screening of different formulations, applied both on wet and on dry concrete specimens, in order to identify the best possible solution in terms of surface protection, ending up with the development of MasterPel 500, that is hereby presented.

The European Standard for paving stones (EN 1338) does not provide any indication for the evaluation of the resistance against staining agents. A suitable test method for the investigation of the anti-soiling effect has been developed internally, adapting the European Standard for ceramic tiles (EN ISO 10545 – chapter 14). The range of staining agents has been widened from 3 to 6, while keeping the green spotting agent in oil and the olive oil, already present in the EN ISO 10545, but introducing also other types of staining agents (coffee, motor oil, mayonnaise and ketchup) that can commonly damage paving stones when laid in restaurants and parking areas, residential terraces or gardens. The liquid stains have been applied on the surface of dry specimens by using a graduated micropipette in order to ensure the same applied quantity in all the tests. The time of stain deposition on the surfaces of the elements has

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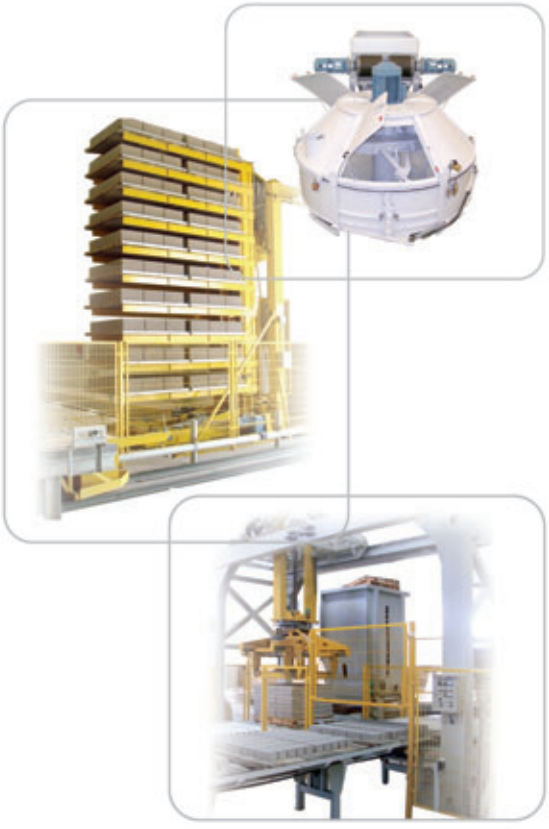

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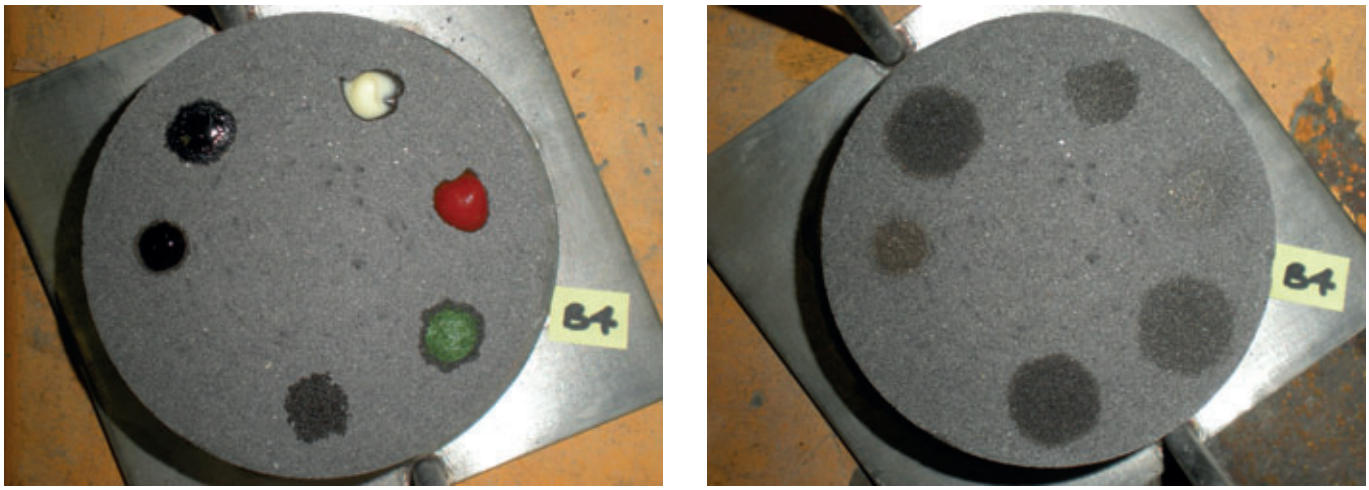

Fig. 1: Reference – application of the staining agents on dry surface

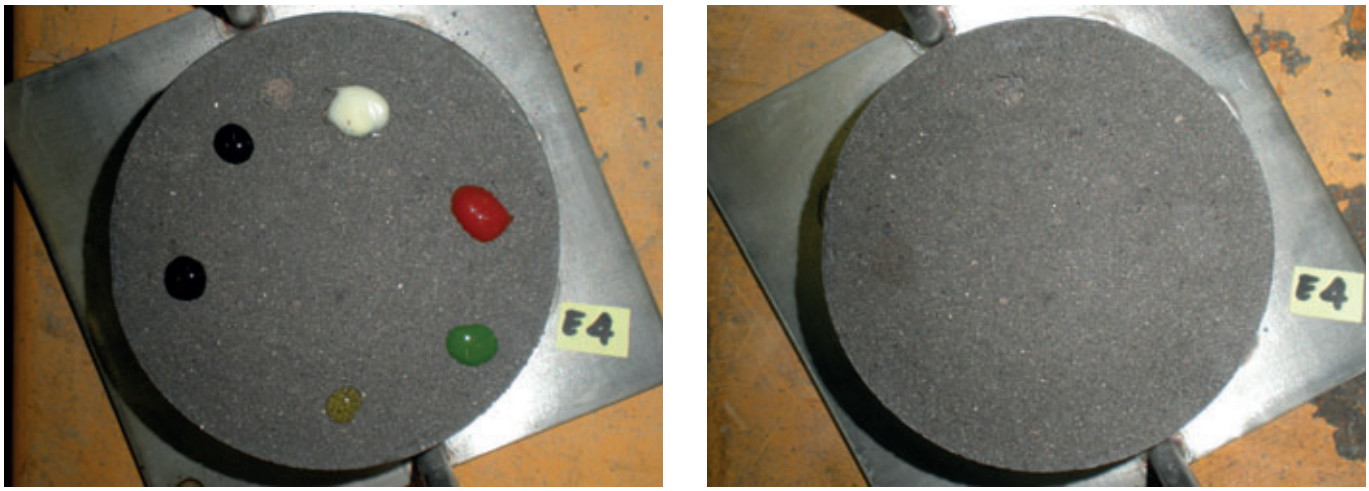

Fig. 2: MasterPel 500 (100 g/m²) – application of the staining agents on dry surface

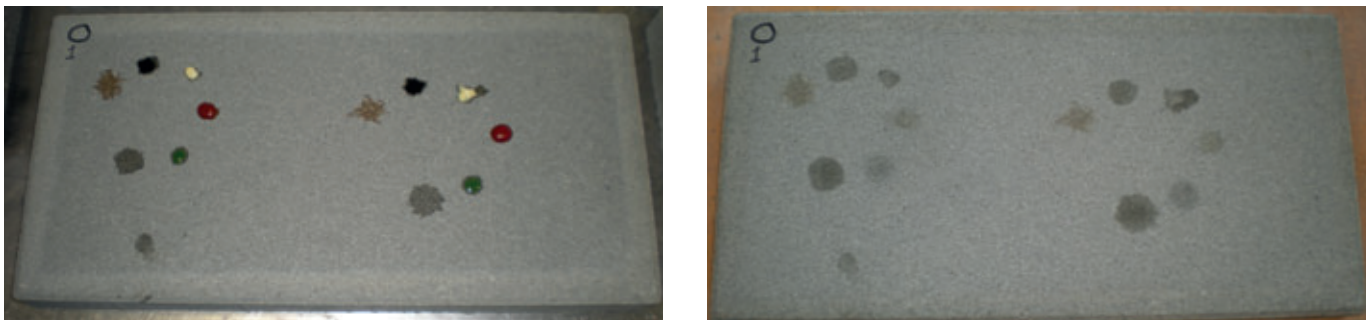

Fig. 3: Reference – application of the staining agents on dry surface

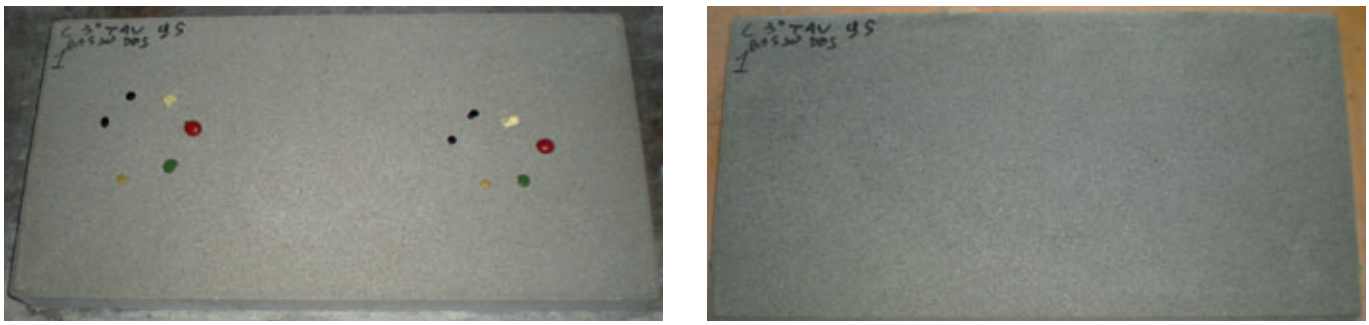

Fig. 4: MasterPel 500 (100 g/m²) – application of the staining agents on dry surface

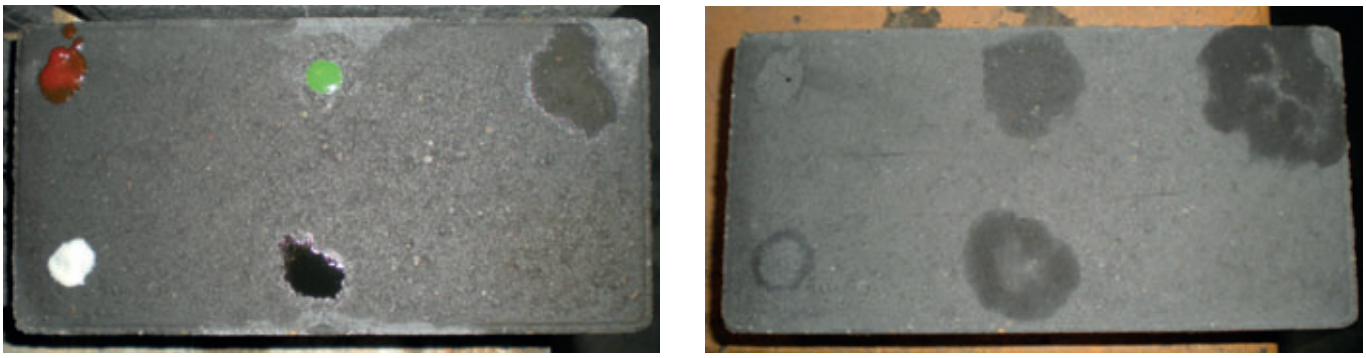

Fig. 5: Reference – application of the staining agents on wet surface

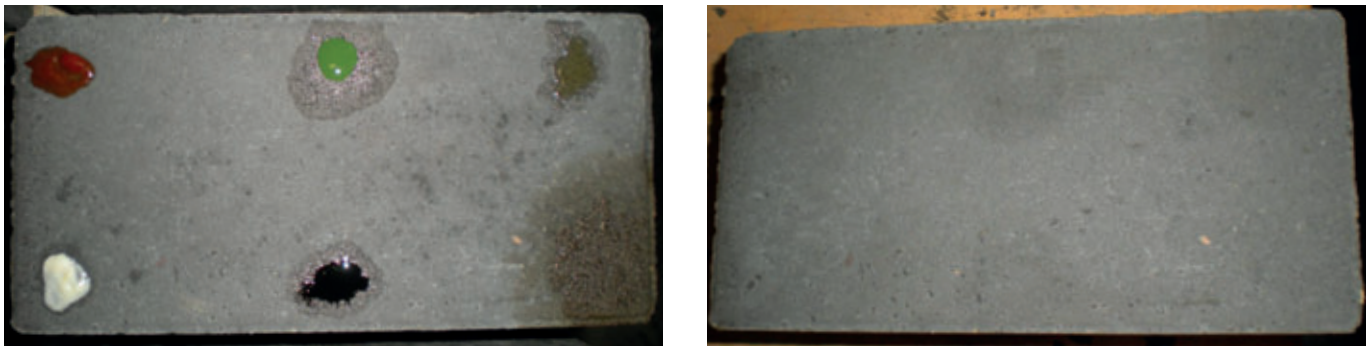

Fig. 6: MasterPel 500 (100 g/m²) – application of the staining agents on wet surface

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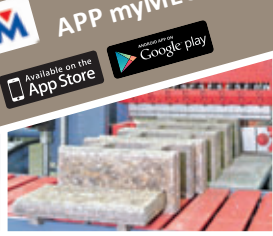

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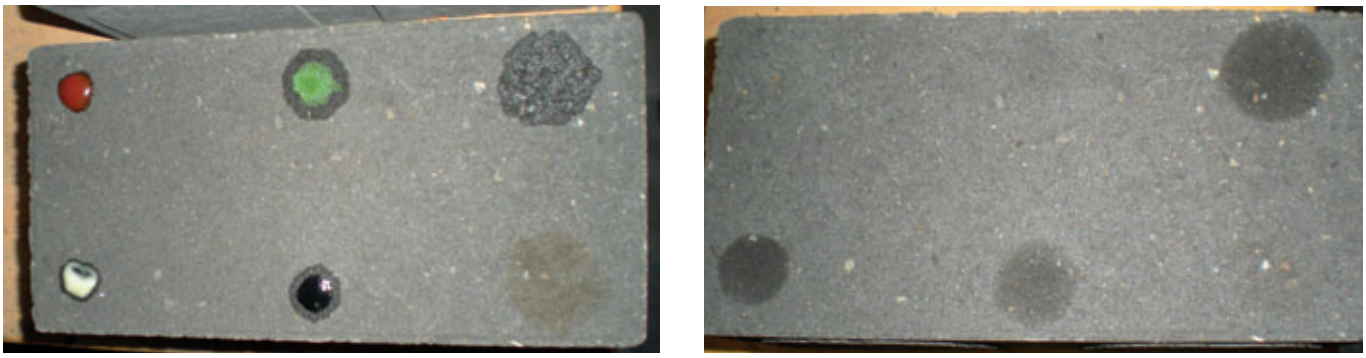

Fig. 7: Reference – after treatment with 5% HCl solution

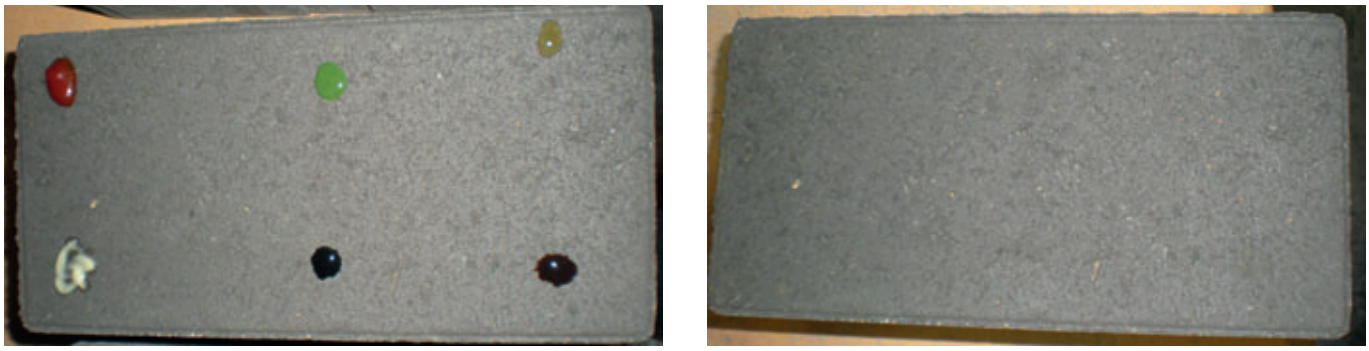

Fig. 8: MasterPel 500 (100 g/m²) – after treatment with 5% HCl solution

been shortened from 24 to 6 hours, due to the more open surface texture of paving stones versus ceramic tiles: it has in fact been observed that the dirt penetration achieved in 6 hours and in 24 hours is the same. Additionally, the cleaning process has been simplified and it does not require the use of detergents and solvents as in the EN ISO 10545, but only high-pressure water. The high-pressure washer used for the tests is a classic version available in the market with a motor power of 1300 W, a maximum pressure of 100 bar and a maximum operating flow of 330 l/h. Finally, after cleaning and drying of the elements, a visual evaluation of the still remaining stains has been carried out.

100 g/m² of MasterPel 500 were sprayed on the surface of fresh PEM specimens immediately after compaction. The elements were cured in the lab for 24 hours at room temperature and 60% relative humidity and then they were stored outside. After 28 days of life, the cleaning test was carried out on treated elements in comparison to the non-treated ones (reference; fig. 1 and 2).

The application was repeated in the production plant, by spraying 100 g/m² of MasterPel 500 on concrete slabs, soon after their compaction and stripping. The elements were placed for 24 hours in the curing chamber and then stacked outside. The results of the cleaning test were again extremely positive and perfectly in line with the lab achievements (fig. 3 and 4).

The evaluation of the cleaning properties provided by MasterPel 500 has also been run by applying the stains on wet treated and not treated paving stones, fully saturated with water to simulate an intensive period of rain (fig. 5 and 6). Additionally, the application of staining agents has been done also after treatment of the element's surface by using a 5% HCl solution to resemble an aggressive environment (fig. 7 and 8). In both cases, the stains can be again easily washed by using hydrojetting.

The protection performance of MasterPel 500 is impacted during the lifetime of the paving stone by abrasion. It is then recommended to provide another application of MasterPel 500 on the surface, to recover the protection performance.

MasterPel 500 is a non-labeled and easy to apply water-based impregnation agent for paving stones that should be applied the first time on still wet concrete, immediately after the compaction process. It does not affect the natural surface appearance of the elements and does not form a film. MasterPel 500 provides excellent oil and water repellency, stain resistance and easy-cleaning properties.

To summarize, this article has presented MasterPel 500, which works like a skin-care for pavers, slabs and all elements made of dry vibro-compacted concrete. In order to achieve superior aesthetics and quality of the whole element, including both the surface and the concrete body, it is recommended, along with the surface application of MasterPel 500, to use the admixtures MasterCast and MasterPel in the mass of concrete. This is the concept of full protection offered by Master Builders Solutions.

The whole system will offer the end users satisfactory performance and beauty of their floors over time.

FURTHER INFORMATION

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