



# GREEN BOOK 3.0

**MATRIX**  
FAMILY ● ● ● ● ●



**SUSTAINABLE AND 100% TRACEABLE**  
First and only in this field.

**MATRIX**  
FAMILY ● ● ● ● ●

# INTRODUCTION

**We have been first in this field for 20 years.**

**Sustainability and circular economy, technical and environmental aspects, environmental analyses and monitoring, applications in Green Building and Green Roads projects.**

**Circular Economy pioneers, since 2001 we have been recycling bottom ash derived from the incineration of municipal solid waste**, of which we are able to recover the entire mineral and metal component.

We turn bottom ash into **Matrix®**, a **manmade aggregate** that can be used in all sectors of Green Building, implementing **a virtuous industrial model of sustainable recovery that can be exported and adapted to all Green Economies across Europe.**

Our philosophy can be summarised in the following words: **'An all-round Circular Economy'**, real, honest and sustainable, but also able to bring in profit for all stakeholders.

**For the above purpose, we pursue total and circular recovery of MSW incinerator bottom ash**, the only raw material we use, converting its mineral and metal component into value on the market, on the basis of a recycling model that is built on **supply chain traceability and final product sustainability.**

## **SUSTAINABILITY: NOT JUST A GOAL, BUT A VIRTUOUS PROCESS.**

At Officina dell'Ambiente, we conduct extensive research in the field of bottom ash recovery, relying on technological development, as well as **solid partnerships with customers**, so that our products can be used in a manner that is conscious and respectful of the environment.

In addition, we measure our environmental impacts through a **Life-Cycle Assessment (LCA)**, enabling us to provide precious data to building material manufacturers, so that they can obtain **environmental validation** of their business and implement an advanced **green positioning** strategy for their products. Our products comply with **Green Public Procurement (GPP) requirements and the Minimum Environmental Criteria (CAM) established by the Italian Ministry for the Environment and Energy Security.** In fact, they were the first in Europe to obtain - in the mineral and aggregates category - the prestigious **Environmental Product Declaration (EPD®)**, validated by Bureau Veritas and recognised by Environdec, as well as the Remade Certification in Italy.



## THE MATRIX® CIRCLE

Officina dell'Ambiente is one of just a few operators in Italy and Europe to interpret this new economic trend in an innovative manner, through the **Matrix Circle®** concept. A traceable supply chain, following the virtuous process of Circular Economy: from the day-to-day production of domestic waste to its incineration into bottom ash, treatment in our plants, reuse in production cycles in the building industry, Green Building projects, and Green Roads.

Our operations are the result of an innovative **circular recovery methodology**, allowing to recycle more than 99% of **incinerator bottom ash**.

## OUR PHILOSOPHY

Our production philosophy is expressed through an emblematic concept: **'No recycling without traceability and awareness of use'**. Indeed, Matrix®:

- displays stable and repetitive technical performances;
- is part of a fully-traced supply chain;
- meets mandatory technical standards for use in a number of building sectors;
- meets voluntary standards allowing to compare environmental performances between equivalent products and ensures that awareness of use is transferred to final customers through a rigorous implementation of the relevant DoP (Declaration of Performance) and Technical Datasheet.

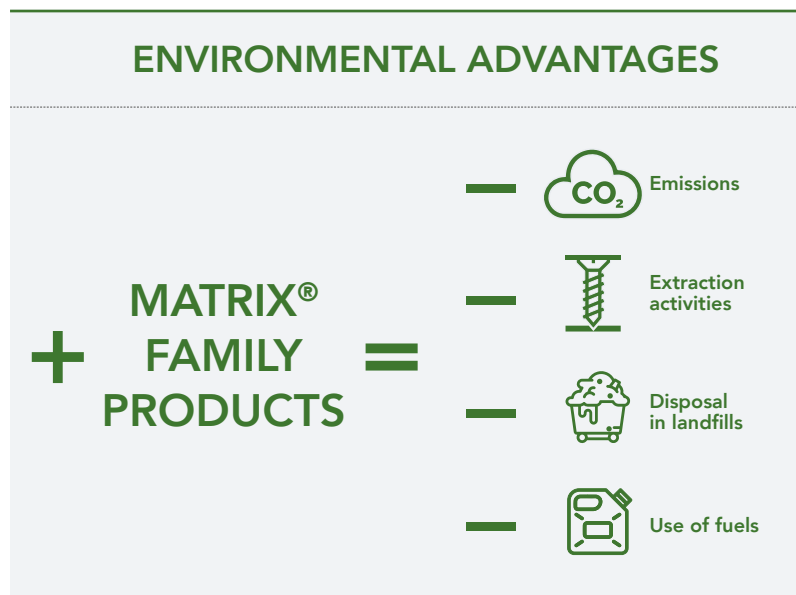


# OUR CONTRIBUTION TO SUSTAINABILITY AND CLIMATE CHANGE

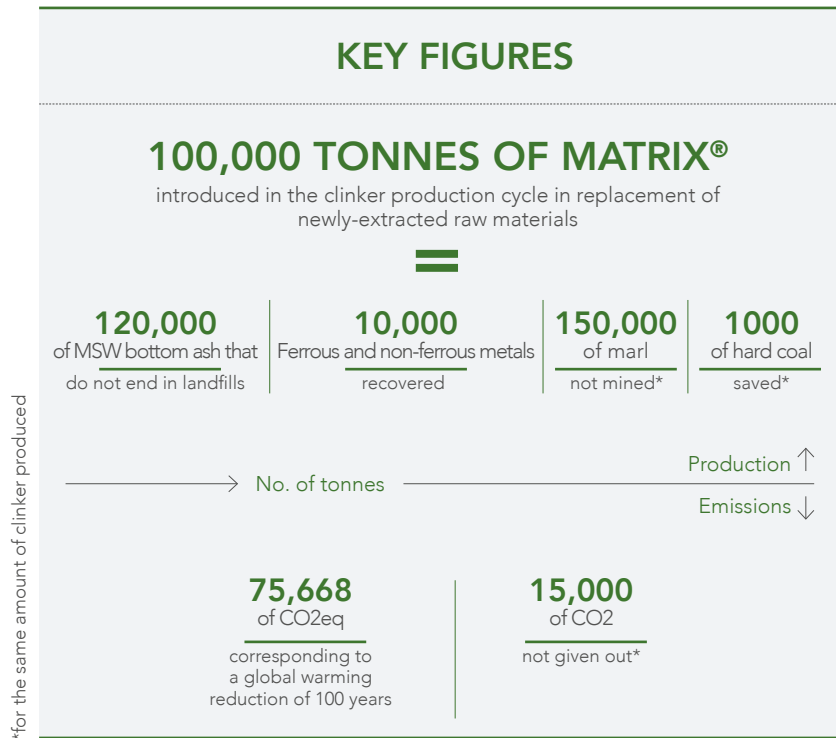
We believe that sustainability is a continuous research and improvement process that begins with the implementation of an advanced environmental management system in our plants and extends all the way to our products, which are designed in synergy with our customers and are able to deliver solutions, innovation, technical competence, **awareness of use** and environmental consciousness, as well as **real economic value** in replacement of newly-extracted raw materials.

## THE ENVIRONMENTAL ADVANTAGES OF MATRIX®

The use of Matrix® in the production of cement and other products for the building and road construction industries brings with it tangible environmental advantages for both customers and users:



Circular Economy can be regarded as such only if it is able to create real value.



Calculations are real and objective: Matrix® was subjected to a voluntary in-depth study - conducted by AMBIENTE ITALIA, a leading company in the field, and validated by certification body Bureau Veritas - which determined actual environmental performances through an analysis of life cycle (Life Cycle Assessment or LCA). The study made it possible to measure environmental impacts in the various stages of the life cycle of Matrix®, from 'cradle to gate', and allowed to rigorously qualify the actual performance of Matrix® products, assessing interactions with the environment and providing customers with accurate reference parameters. For AGMATRIX® and SandMatrix®, the LCA study also led to the preparation and subsequent approval of the EPD® certification.

The use of Matrix® has a much more sustainable impact than almost all of the other categories considered. In addition, its life cycle has two definite environmental benefits:

- it avoids linear disposal of bottom ash in landfills, which prevents closing of the virtuous cycle;
- it allows to recover considerable amounts of scrap metal (ferrous and non-ferrous), including aluminium, which are recycled in second smelting foundries.

The table below reports the environmental impacts associated with the life cycle of the Matrix<sup>®</sup>, comparing them with corresponding values for natural sands, as obtained from international databases.

## COMPARISON BETWEEN SAND MATRIX<sup>®</sup> 0-2 MM (WITH AND WITHOUT AVOIDED IMPACTS) AND SAND

(Values referred to 1 ton of Matrix<sup>®</sup>)

IMPACT CATEGORY	UNIT	* SAND MATRIX <sup>®</sup>	** SAND MATRIX <sup>®</sup>	*** SAND MATRIX <sup>®</sup>	SAND (ECOINVENT DB)	SAND (ETH DB)	SAND (ELCD DB)
Global warming (100 years)	kgCO <sub>2</sub> eq	36.6	-664.08	-713.51	2.62	9.79	2.46
Depletion of ozone layer	mgCFC-11eq	5.9	2.85	-0.63	0.41	12.09	0.38
Forming of photochemical smog	gC <sub>2</sub> h <sub>4</sub>	3.2	-145.02	-222.52	0.45	0.88	1.08
Acidification	gSO <sub>2</sub> eq	160.0	-159.33	-582.06	17.89	31.03	20.38
Eutrophication	gPO <sub>4</sub> eq	26.7	-2,812.68	-2,893.90	3.54	5.97	2.03
Human toxicity	kg1,4-DBeq	11.6	-201.30	-248.93	0.40	0.98	0.11
Ecotoxicity to freshwater	kg1,4-DBeq	6.3	-2,163.32	-2,200.81	0.35	0.15	0.00
Ecotoxicity to seawater	kg1,4-DBeq	7,763.8	-1,040,612.5	-1,140,627.6	1,575.16	1,840.38	609.85
Ecotoxicity to land	kg1,4-DBeq	0.0	-1.52	-1.76	0.00	0.00	0.00
Land use	m <sup>2</sup> a	0.1	-0.70	-1.75	0.04	4.62	0.00
Water consumption	m <sup>3</sup>	0.210	-0.180	-0.080	0.011	0.093	-0.011
Consumption of renewable primary energy resources	MJeq	0.202	-0.181	-0.148	0.016	0.093	-0.011
Consumption of renewable primary energy resources as raw materials	MJeq	58.255	23.652	3.358	5.273	2.918	2.358
Consumption of non-renewable primary energy resources	MJeq	0.020	-0.273	-0.702	0.076	0.037	0.0
Consumption of non-renewable primary energy resources as raw materials	MJeq	461.838	202.959	-370.008	42.675	150.554	28.831

\* 0-2 mm

\*\* 0-2 mm including avoided impact from landfill disposal

\*\*\* 0-2 mm including avoided impacts from landfill disposal and primary production of Fe and Al

# THE FOUNDATIONS OF OFFICINA DELL'AMBIENTE'S OPERATIONS

## WHAT DO WE MAKE?

### An End-of-Waste product

The Matrix® Family is a range of products obtained from the industrial treatment of the bottom ash generated during the incineration of Municipal Solid Waste (MSW). These products, which were previously known as **Secondary Raw Materials** (SRM), are now classified as **End-of-Waste** (EoW) products and are used as a replacement of newly-extracted raw materials in the production of cement and other products for the building and road construction industries.

## THE MATRIX® FAMILY PRODUCTS

**Matrix® Standard** A grey granular material, with a grain size ranging from 0 to 10 mm.

**AGMatrix®** Wet-refined grit, with a grain size ranging from 2 to 10 mm.

**Sand Matrix®** A range of sand products, with grain sizes 0-2 mm, 0-4 mm and 2-4 mm.

**BitMatrix®** Grit with a grain size ranging from 4 to 12 mm.

## WHO MAKES IT?

### Officina dell'Ambiente S.p.A.

The Matrix® Family products have been made by **Officina dell'Ambiente S.p.A.**, in its two modern plants for the treatment of MSW incinerator bottom ash, **since 2001**.

**OdA is an innovative company**, who has chosen to develop its core business through the most advanced eco-sustainable industrial development policies, on its two ISO 14001-certified and EMAS-registered sites, its approach focusing, in particular, on the recovery of a single waste-type for the purpose of its re-use in replacement of newly-extracted materials, in line with the most advanced indications of EU and national regulators. The above in full adherence with circular economy practices.

## WHERE IS IT MADE?

### **Lomello Plant (Pavia, Italy).**

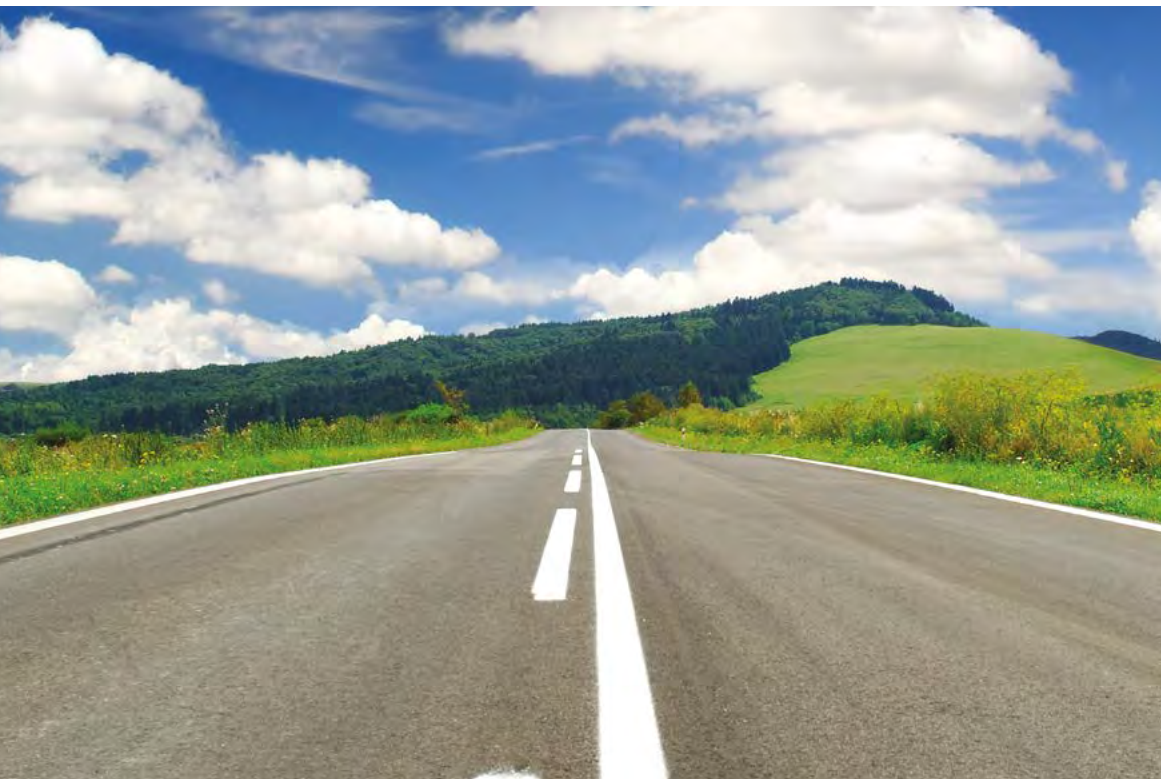
For over 20 years, Officina dell'Ambiente has been conducting its incinerator bottom ash recovery operations in its up-to-the-minute plant in Lomello (Pavia, Italy), comprising also a photovoltaic system (serving the plant's energy requirements), as well as all the additional facilities that may be required on a modern industrial site. Lomello is our original site, with an authorised capacity of 250,000 tonnes/year.

### **Conselice plant (Ravenna, Italy).**

In the light of the industrial success obtained by Officina dell'Ambiente in Lomello, a new plant was built in the municipality of Conselice (Ravenna, Italy), which has been operating since 2015, with an authorised waste treatment capacity of 250,000 tonnes/year. The Conselice site too can rely on a photovoltaic system serving the site's requirements.

The two production units have a **total treatment/recovery capacity of 500,000 tonnes/year**. The operations conducted in the plants are regulated in their respective Integrated Environmental Authorisations, describing the various steps throughout the entire recovery cycle, which culminates with the conversion of the waste into an **End-of-Waste** industrial aggregate to be used in the industrial sectors of the building and infrastructure industries, in full compliance with the applicable technical and environmental legislation.

**In a virtuous cycle, once converted into Matrix, MSW incinerator bottom ash ceases to be classed as waste and becomes a primary raw material, a certified Green Building product that can be used reliably and repetitively.**





## WHAT IS IT MADE OF?

### MSW incinerator bottom ash.

The Matrix® Family products are the first example in Italy and Europe of an industrial approach – involving significant economies of scale - to the recovery and recycling of MSW incinerator bottom ash, which is their only raw material. From an industrial perspective, the decision to use a single waste-type has allowed:

**1 To guarantee the total traceability of the waste treated, from its origin to its final re-use.**

**2 To deal with a stable and repetitive chemical matrix.**

**3 To achieve the required technical standards** (as prescribed by the applicable UNI EN regulation and REACH certification) for a correct use of the Matrix® products in the industry sectors in which they are currently marketed.

**4 To supply end users with products that have characteristics of stability and repetitiveness** – requirements that must be met if the industrial and long term use of the Matrix® Family products is to be pursued. Coming from the treatment and mixing of a single waste-type, Matrix® presents a highly uniform and repetitive composition, consisting mostly of silica and smaller amounts of calcium, with the quality and quantity of macro components remaining largely stable.

**5 To ensure the accurate and totally transparent management** of all environmental aspects linked to the production cycle, with full approval by the competent supervisory bodies.

**6 To obtain the first EPD® certification in Europe** for an aggregate of industrial origin for the building industry, based on a thorough Life Cycle Assessment (LCA).

## WHERE DOES THE WASTE/BOTTOM ASH (I.E. THE RAW MATERIAL) COME FROM?

**Exclusively from bottom ash produced by Municipal Solid Waste incinerators in Italy, following controlled processes that are also respectful of the environment.**

The entire waste workflow, from arrival to the plant and pre-assessment in the company's lab to continual processing, is regulated in a specific Workflow Protocol approved by the Pavia Province Council and the Ravenna Province Council, which is regularly implemented in all operations carried out in the plants.

## SELF-LIMITING CODE ON INCOMING INCINERATOR BOTTOM ASH

**Officina dell'Ambiente's production cycle involves, in both sites, a series of SELF LIMITATIONS, whose purpose is that of further increasing the - already high - technical standards of the Matrix® products:**

**NO bottom ash is accepted under any circumstances from waste-to-energy plants** that treat Industrial Special Waste, even when chemical and physical characteristics are in theory compatible; only bottom ash from MSW incinerators is used.

**NO other types of waste are accepted or treated under any circumstances**, despite the fact that Officina dell'Ambiente's authorisation includes other categories of waste; no mixing of any type takes place.

**NO waste is accepted under any circumstances from intermediate storage centres**, only bottom ash coming directly from individual MSW incinerators is treated, ensuring the traceability and specificity of all incoming materials.



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## THE NORMATIVE REFERENCE

**Officina dell'Ambiente's operations fall within the normative framework regulating the treatment/recovery of waste for the purpose of its re-use as an End-of-Waste product** in replacement of newly-extracted raw materials, in line with the most advanced indications of EU and national regulators.

For applicable requirements, refer in particular to articles 4) and 6) of Italian Legislative Decree No. 205/2010, according to which waste management should focus primarily on prevention, secondarily on 'preparation for re-use' (a novelty introduced by Directive 2008/98/EC), recycling and recovery and only as a last resort on disposal. In this context, Officina dell'Ambiente's operations fall clearly within the meaning of article 184ter of Italian Legislative Decree No. 205/2010, introducing the concept of 'End of Waste' (EoW): once it has undergone specific recovery processes, waste ceases to be classed as waste and can once again be sold on the market as a product.

## ODA'S AUTHORISATIONS

**Officina dell'Ambiente's treatment and recovery operations in the Lomello plant are currently regulated in Integrated Environmental Authorisation** No. 12566 of 25/10/2007, issued by the Lombardy Region Council, and Non-Substantial Amendment Authorisation No. 1/16 of 20/04/2016.

Officina dell'Ambiente's treatment and recovery operations in the Conselice plant are authorised by the Ravenna Province Council with Integrated Environmental Authorisation No. 4071 of 19/12/2013, and integrated by Authorization No. 2017-507 of 3/2/2017 issued by Arpae of Ravenna for the activities referred to under Italian Legislative Decree No. 152/06 Part II, and, in particular, for the operation of a plant for the recovery of inert matrix special waste (incinerator bottom ash).

The above authorisations regulate both the treatment/recovery of waste and the production and marketing of the Matrix® EoW products.

Introduction into a new specific industrial sector is NEVER ACCIDENTAL, rather it is always the result of a preliminary technological process, aimed at verifying technical feasibility on a laboratory level, followed by an accurate and selective industrial trial period, seeking to verify the actual possibility of wide-scale application, as well as compliance with the relevant operating standards.

# THE MATRIX® FAMILY PRODUCTION CYCLE

## 1 INCOMING WASTE CHECKS

1 Officina dell'Ambiente's production operations are organised so that incoming waste can be **effectively and repetitively monitored through strict and accurate preventive routine checks**, as described in the Waste Acceptance and Management Procedure set out in the Integrated Environmental Authorisations for the two sites.

## 2 INCINERATOR BOTTOM ASH STOCKPILING AND AGEING

Incoming waste is stockpiled in specific covered areas, where it undergoes a special ageing process called **LITHO-STABILISATION®**. Here, the material is stored in a safe condition, under shelter, on an impermeable floor surface.



### 3 TREATMENT

The entire treatment cycle for the production of Matrix® is carried out indoors, within enclosed buildings, again with impermeable floor surfaces.

After the initial **LITHO-STABILISATION®** phase, in the dedicated areas, the waste is led - through hoppers and conveyor belts - to a system of crushing mills and screens, with dedicated systems for the separation of ferrous and non-ferrous metal fractions, whose purpose is that of refining the material to the expected standard. Both plants, which are totally automated, **feature soundproofed walls**, so as to minimise noise impact in production areas and towards the outside. Production areas are also fitted with **an extensive and efficient air extraction/treatment system**. All floor surfaces, external and internal, are cleaned on a daily basis by an operator using a rider sweeper.

### 4 STORAGE

The Matrix® finished product is stored on purposely-surfaced external yards, where the **LITHO-STABILISATION®** process continues until completion.

Both plants can rely on dedicated **watering** systems, to ensure that the correct level of moisture is present in the finished products during handling and transport operations.



# ENVIRONMENTAL SUSTAINABILITY OF THE PRODUCTION PROCESS

**The technical and environmental choice of using only one type of waste makes our production process a lot simpler** than others in the sector, where waste is heavily mixed in ways that cannot be easily monitored. Oda's approach translates into a highly repetitive process, which is synonymous with predictability, stability and environmental control obtained through the use of a single waste-type.

## THE LITHO-STABILISATION® PROCESS

**Bottom ash from MSW incineration** is the only raw material used by Officina dell'Ambiente. **Incinerator bottom ash is a heterogeneous, yet statistically repetitive mixture, whose overall chemical composition is similar to that of natural minerals** (basalt, marl, etc.) and is characterised by a minimal presence of metals, from some of the objects, or part of the same, that are normally found in domestic waste (small metal objects, cutlery, etc.). Metals are found in all raw materials and therefore do not represent a reason for concern as such. In bottom ash, in particular, metals come in a stable chemical form (mostly as oxides) and very rarely leach into the external environment. This means that an informed use of Matrix®, in the percentages recommended in the Declaration of Performance, allows for application that is not prejudicial to the environment.

Due to the fact that it is the product of incineration and that it has been subsequently put out with water, bottom ash presents technical, operating and workflow-related aspects - both in physical terms (high moisture content) and chemical terms (highly alkaline pH) – that require careful industrial management. **This is why preliminary chemical and physical stabilisation is essential** to enable the correct upstream management of the treatment process and successful downstream recovery of the material. If the above process is carried out correctly, it will eventually lead, at the end of the supply chain, to the production of Matrix® Inside products in which the bio-availability of metals is minimised and is, in any case, fully under control in the production process.

**As is often the case, the means to obtain effective chemical and physical stabilisation is provided directly by nature: litho-stabilisation®.**

Officina dell'Ambiente adopts a simple and natural solution which promotes lithification: a process internationally known as 'natural weathering', which was successfully developed in Japan at the beginning of the '90s and involves a specific methodology for the natural ageing of incinerator bottom ash during its various processing stages, over a period that ranges between 45 and 90 days.

**In a nutshell, LITHO-STABILISATION® is a true chemical process, completely natural, which does not require the use of chemical substances or additives and whose outcome is the 'CONTROLLED CHEMICAL AND PHYSICAL STABILISATION' of incinerator bottom ash.**

Incoming incinerator bottom ash is stockpiled in **LITHO-STABILISATION® AREAS**, where a series of natural and spontaneous phenomena take place, including: the rising of temperature, the oxidation of aluminium, absorption and neutralisation by atmospheric carbon dioxide (carbonation), the precipitation of insoluble carbonates, the partial absorption of heavy metals by iron oxide, the formation of new mineralogical phases, etc.

As a whole, these natural phenomena contribute to lowering the natural pH of incinerator bottom ash and promote the stabilisation of some of its chemical components. The above processes take place and develop in a continual manner, from the initial stockpiling phase (pre-treatment) up to the final storage of Matrix® (post-treatment).



## MATRIX® IN FINAL PRODUCTS: NATURAL STABILITY

Over the years, Officina dell'Ambiente has studied, tested and applied Matrix® with dozens of producers, giving its contribution to the creation of products that can be used in sustainable building and infrastructure construction. Officina dell'Ambiente has chosen **NOT** to market Matrix® in sectors where traceability and control are not guaranteed and where direct contact with the external environment is to be expected.

**Officina dell'Ambiente has made a technical choice to introduce Matrix® only in industrial processes that are subject to clear identification and monitoring requirements** and stringent operating standards, in both firing (cement, bricks and ceramic) and cold processes (concrete, mortar, bituminous conglomerates, cement products) involving the presence of cement, bitumen or clays.

Indeed, the above substances have a high binding power and facilitate the chemical stabilisation of those products in which Matrix® is introduced in limited and carefully-calculated percentages, as part of specific pre-defined formulations.

Stability is also favoured by the significant pozzolanicity properties inherent in incinerator bottom ash, which has a natural tendency to act as a binder, so much so that the stockpiling phase in the LITHO-STABILISATION® AREAS must be carefully managed so as to avoid the occurrence of hardening effects, which would slow down the treatment process and consequently reduce the production capacity of the plants.

To further technical control over this aspect, a decision was made to measure the effectiveness of the above processes in the long term, in an effort to understand what sort of impact a Matrix® Inside product will eventually have on its micro-environment. Our now twenty-year long experience forms a body of technical and scientific knowledge that we make available to the building and infrastructure industry.

For the above purposes, Officina dell'Ambiente has voluntarily introduced a strict verification procedure, in the continuing absence of a dedicated implementation standard, which is deemed to be ethically, environmentally and technically essential in order to understand the actual sustainability of a Matrix® Inside product, in line with the guidelines provided under article 184/ter of Italian Legislative Decree No. 152/2006.

On a micro-environmental level, this brings in the notion of 'END OF LIFE' (see page 22) while on a macro-environmental level it refers to the notion of 'LIFE CYCLE' assessment (see page 24).



# ENVIRONMENTAL MONITORING ON THE MATRIX® FAMILY PRODUCTS

## WHAT MONITORING?

All products obtained through the above treatment are subjected to strict **monitoring of content values of the main inorganic constituents and heavy metals**. The main organic pollutants are also regularly measured (dioxins/furans, polycyclic aromatic hydrocarbons and polychlorobiphenyls), with results always turning out to be either zero or extremely low in value. Indeed, the above substances are not found in incinerator bottom ash at the end of the incineration process and, therefore, are not found in Matrix® either.

## WHY?

**So as to ensure that the products offer constant quality standards** and feature environmental characteristics that are compatible with the applicable legislation and operating standards.

## WHEN?

Chemical analyses on the Matrix® Family products are normally conducted on a **monthly** basis using average samples that are representative of the plant's production.

## PERFORMED BY WHOM?

**Since 2001, Officina dell'Ambiente (OdA) has been running its own in-house chemical and technological laboratory, a necessary instrument for the correct performance of production activities, which is responsible for:**

- monitoring compliance with authorisation requirements;
- ensuring a systematic approach to quality checks on incoming waste and outgoing products;
- conducting rigorous scientific research, on which Officina dell'Ambiente has been investing for years, with the purpose of expanding its range of sustainable applications for the Matrix® Family products in the building and construction industry in general.

**The chemical laboratory can rely on modern technical equipment and is headed by a chemist duly registered with the relevant professional association, having more than 15 years of experience in the study of MSW bottom ash and its operational applications.**

The equipment available in the laboratory (mills, microwave digester, muffle furnace for alkaline fusions, inductively-coupled plasma spectrometer for metal detection, etc.) is suitable to conduct chemical analyses on complex matrices, such as incinerator bottom ash. The laboratory is also equipped to perform the physical/mechanical tests required to maintain the products' CE markings. Accredited external laboratories are used for more complex determinations.

# ENVIRONMENTAL MONITORING ON THE MATRIX® FAMILY PRODUCTION PLANTS



## WHAT MONITORING?

Officina dell'Ambiente's plants are monitored through strict monitoring plans, as set out in their respective Integrated Environmental Authorisations.

## WHY?

The Integrated Environmental Authorisations issued for Officina dell'Ambiente's two production sites, as well as the environmental management systems adopted in the plants under their voluntary certifications (ISO 14001 and EMAS), impose careful monitoring of environmental conditions in the industrial sites, **involving specific checks on incoming and outgoing waste, as well as on air, water, soil and noise values.**

## PERFORMED BY WHOM?

The above monitoring is carried out as a self-monitoring activity, using both the company's internal lab and accredited external labs. As the plants are subject to **Integrated Environmental Authorisation**, monitoring results are transmitted to the competent authorities for review.

In addition to standard environmental monitoring, Officina dell'Ambiente has also conducted important investigations assessing effects on the surrounding environment, which it entrusted to leading national research institutes, in agreement with local authorities.

The findings of the above environmental investigations have ruled out the possibility that OdA could be playing a role in circulating dusts and micro-pollutants in the areas surrounding the plants.



# THE ENVIRONMENTAL CHARACTERISTICS OF THE MATRIX® FAMILY PRODUCTS

## DIOXINS

Notoriously, the combustion of MSW generates minimal traces of dioxins, which are then found in the flue gases and are abated at the incinerator's stack in the form of light ash, a hazardous waste type which is disposed of in dedicated authorised plants.

Vice versa, **the ash which collects at the bottom of the furnace and constitutes the raw material for the production of Matrix® is practically dioxin-free**, because of the high temperatures reached during the thermal destruction process.

In an effort to confirm this, a leading international cement manufacturer has carried out a scientific study (lasting over a period of approximately 2 years) into the potential dioxin emissions from the plant's stack associated with Matrix®.

The results showed that a use of Matrix® in replacement of natural marl in percentages ranging on average between 1% and 5% of the total raw meal does not affect the quality of the cement or of the emissions into air.

## DUSTS

Like natural raw materials, Matrix® is made up of silicon carbonates and oxides, aluminium, iron, calcium and, in smaller amounts, sodium, potassium, phosphorus, sulphur, magnesium and other metals. Silica, both in its amorphous and crystalline form, is the main component and accounts for almost 50% of the total.

During industrial handling and use, Matrix® **does not generate dusts**, as it retains a level of moisture that is normally higher than 15% and therefore makes for a limited dispersion. In addition, due to the product's grain size, the presence of silica in the breathable fraction of the dusts is extremely low (< 0.1%).

## ODOURS

The raw material for the production of **Matrix®**, i.e. the bottom ash from the incineration of MSW, has undergone a thermal destruction process and, as such, it is characterised by an extremely low organic residue, which is practically free of odorous substances. The only olfactory aspect of Matrix®, and an almost insignificant one, is the slight odour, similar to that of cement, that can be smelled in the immediate vicinity of the piles.

## HEAVY METALS

The Matrix® Family products, as incinerator bottom ash in general, contain significant but constant levels of microconstituents (mostly heavy metals).

However, anticipating future regulatory requirements on recovered materials, Officina dell'Ambiente has long chosen to operate under strict rules for the control of the long-term impact of the use of Matrix® in the building industry.

For this purpose, final products containing Matrix® Family materials carrying the CE marking are regularly subjected to leaching test, measuring the potential release of pollutants at '**END OF LIFE**' (when they will be demolished). Results are then compared with the limitations established by the applicable regulations on the recovery of inert waste.

Matrix® Family products for all applications for which CE marking is required are accompanied by a specific **Declaration of Performance (DoP)**, attesting conformity with the requirements of a specific technical standard and indicating the maximum percentage quantities to be used in production. The final goal is that, at the end of its life, the cement or bitumen-based product containing Matrix® has pollutant release levels that are lower than the limits set out in Italian Ministerial Decree No. 5/02/1998, as amended and supplemented, and can therefore be classed as 'conventional' demolition waste, that can be recovered in the normal authorised inert waste plants.

As further confirmation that these components (heavy metals) are present in a chemically stable form, in compliance with the regulation on the classification and labelling of substances (Regulation 1272/2008 – CLP), **Matrix® is regularly subjected to ecotoxicity testing and is constantly found to be non ecotoxic for the aquatic species for which the regulation requires testing (fish, crustaceans and algae).**





Raw material  
extraction



Material processing



Part manufacturing



Assembly



Product use



End of life

## SAFETY DATASHEETS

All Matrix® Family products have their own Safety Datasheet, in compliance with the requirements of EU Regulation 1907/2006/EC (REACH), as amended and supplemented.

## LIFE CYCLE

L'approccio più innovativo per conoscere la prestazione ambientale. The most innovative approach to determine the environmental performance of a product is the so-called **Life Cycle Assessment (LCA)**.

An LCA study allows to assess the environmental impacts associated with the various stages in the life cycle of a product and may include the entire life cycle, from extraction of raw materials to final disposal of the product.

For AGMatrix® and SandMatrix®, a 'cradle to gate' LCA study (use and disposal of the products were not considered) was carried out for the obtainment of the EPD® Certification.

The study was conducted by one of the leading Italian firms in the sector (AMBIENTE ITALIA) and was then validated by certification body Bureau Veritas.

The in-depth study of the product's life cycle and the rigorous assessment carried out through the LCA methodology have allowed to validate the actual performance of the Matrix® products in terms of their environmental aspects, that is of their interaction with the environment.

**LCA (Life Cycle Assessment):** a process that allows to assess the environmental impacts associated with a product, process or activity through the identification and quantification of the materials and energy used and of the emissions released into the environment, as well as to identify and assess opportunities to reduce these impacts (SETAC) during life ('from cradle to grave').

**EPD® (Environmental Product Declaration):** a declaration of environmental performance providing verified and comparable information regarding the environmental impact of a product or service. It is obtained through the completion of an LCA assessment in accordance with the framework rules set out for the various product categories (PCR – Product Category Rules), indicating the rules, requirements and technical characteristics for each specific product category.

The EPD® Certification is issued by the Swedish Environmental Management Council, who manages the International EPD® System, following verification by an accredited external body.

([www.environdec.com](http://www.environdec.com))

# MATRIX® FAMILY CERTIFICATIONS



## ODA'S SITE CERTIFICATIONS

Both sites have obtained environmental certifications under standard ISO 14001 and EMAS Registration under Regulation. 2009/1221/EU.

In both sites, environmental certification is supplemented with the adoption of a Quality Management System under standard ISO 9001:2018.

## PRODUCT CERTIFICATIONS

OdA's Production Control System has been certified to Regulation 305/2011/EU by recognised building sector certification body ICMQ since 2008.

OdA offers a range of aggregates that carry the CE marking, indicating compliance with a number of technical standards for the construction industry. Currently, as many as 5 Matrix® Family products carry the CE marking under the following harmonised technical standards: UNI EN 12620, UNI EN 13139, UNI EN 13043, UNI EN 13242.

Last but not least, **all products in the Matrix® Family have completed the process under UNI EN ISO 14021** authorising the issue of a self-declared environmental claim, validated by third-party body ICMQ, to attest recycled content.

**100% post-consumer recycled content.**



## MATRIX® FAMILY PRODUCT CERTIFICATIONS

MATRIX® FAMILY PRODUCTS	AGMATRIX® 2-10mm	SAND MATRIX® 2-4 mm	SAND MATRIX® 0-2 mm	SAND MATRIX® 0-4 mm	MATRIX® 4-12 mm
UNI EN 12620 Concrete	System 2+	System 4		System 4	
UNI EN 13043 Bitumen		System 2+	System 2+	System 2+	System 2+
UNI EN 13242 Cement-bound mixtures	System 4			System 2+	System 2+
UNI EN 13139 Mortars			System 2+	System 4	





## EPD<sup>®</sup> CERTIFICATION

In 2013, Officina dell'Ambiente obtained from Bureau Veritas the validation of its **Environmental Product Declaration or EPD<sup>®</sup>** (which is subject to annual maintenance inspections) **for its products SandMatrix<sup>®</sup> and AGMatrix<sup>®</sup>**.

This was **the first case in Europe - and is still one of just a few today - of an EPD<sup>®</sup> applied to building aggregates** and is now a reference for Green Building.

The in-depth study of life cycle and rigorous assessment carried out by Officina dell'Ambiente through the LCA methodology has allowed to determine the actual performance of the Matrix<sup>®</sup> products in terms of their environmental aspects, that is of their interaction with the environment.

The positive aspects associated with this validation are:

- the consolidation of our commitment towards sustainability;
- the guarantee, for consumers and commercial partners, that they can make conscious and scientifically validated purchase choices;
- the possibility for Matrix<sup>®</sup> users to create specific green ranges (cement products, mortars, etc.) with a known and validated environmental footprint, calculated using - for the part of recycled material consisting of the Matrix<sup>®</sup> product - the data already available on the EPD<sup>®</sup>;
- the possibility to be included in supply chains for Green Procurement and/or requiring compliance with Minimum Environmental Criteria (CAM);
- the implementation of a system for the continuous improvement of the environmental quality of products, using the EPD<sup>®</sup> results as the starting point for the overall process.

**Matrix<sup>®</sup> is the first aggregate in Europe to have obtained the Environmental Product Certification (EPD<sup>®</sup>) - through validation by Bureau Veritas - for its products SandMatrix<sup>®</sup> and AGMatrix<sup>®</sup> ([www.environdec.com](http://www.environdec.com))**

The latest protocol for the **LEED<sup>®</sup> Certification** - standard LEED<sup>®</sup> v4.1 - awards additional credits (Materials and Resources section) to those construction products and materials that have an **Environmental Product Declaration (EPD<sup>®</sup>)**, and, more in general, to those products for which life cycle information is available (LCA).

The attention given by the LEED<sup>®</sup> Certification system to the LCA/EPD<sup>®</sup> element shows how much demand there is in the sustainable building industry for products and materials with these credentials (and this can only grow in future).

## MATRIX® AND THE REACH REGULATION

Regulation 2006/1907/EC, better known as **REACH**, is the **EU standard establishing the criteria for the Registration, Evaluation and Authorisation of Chemicals**. The public body responsible for verifying compliance with REACH requirements and issuing the relevant sale authorisation is the European Chemicals Agency (ECHA), based in Helsinki.

The ECHA-issued document 'Guidance on waste and recovered substances' (Rev. 2, May 2010) clarifies that:

- waste is exempt from registration;
- Secondary Raw Materials whose physical and geometrical characteristics prevail over chemical composition are classified as Articles and are exempt from registration;
- Secondary Raw Materials whose chemical characteristics prevail over form are to be regarded as Preparations.

**The Matrix® products are classified as Mixtures and, as such, are subject to REACH obligations.**

From the start of the REACH registration system, no specific consortium has ever been set up by European producers of MSW incinerator bottom ash in relation to the REACH registration process (like it has instead been done for other types of waste). As a consequence, Officina dell'Ambiente has proceeded to register the individual chemical components of Matrix® independently, without leaving out any critical elements and strictly following the specific classification and labelling criteria set out in the CLP Regulation.

Matrix® is a mixture of a variety of substances and its main 4 components - calcium carbonate, iron oxides, aluminium and calcium – are all subject to registration. The bureaucratic procedure lasted over 2 years and reached its crucial stage on 30/11/2010, when the registration dossier was sent out. The four substances have obtained final registration under the numbers indicated in the table below.

### PRODUCT REGISTRATION

SUBSTANCE	SUBMISSION NUMBERS	ECHA REGISTRATION NUMBER
Al <sub>2</sub> O <sub>3</sub>	JY596698-77	01-2119529248-35-0153
Fe <sub>2</sub> O <sub>3</sub>	VP596713-99	01-2119457614-35-0067
CaO	GD596706-33	01-2119475325-36-0215
CaCO <sub>3</sub>	UW596704-85	01-2119486795-18-0114

As these substances are the main components of all of our products, **we can safely say that the entire Matrix® Family is REACH compliant.**



## THE REMADE IN ITALY® CERTIFICATION

In 2015, Matrix® became the first aggregate recycled from Incineration Bottom Ash (IBA) in Italy to obtain the REMADE IN ITALY® Environmental Certification for its products Matrix® Standard, SandMatrix® and AGMatrix®.

The REMADE IN ITALY® certification is proof of recycled content - for both the works as a whole and individual components - in the Minimum Environmental Criteria (CAM) for public procurement published by the Italian Ministry for the Environment. ([www.remadeinitaly.it](http://www.remadeinitaly.it))

## MATRIX® FOR GREEN PUBLIC PROCUREMENT

The Matrix® Family products, in perfect strategic harmony with the principles of Circular Economy, meet all technical and legislative requirements deriving from recent developments in Green Public Procurement (GPP), as well as the Minimum Environmental Criteria (CAM) established by the **Italian Ministry for the Environment and the Protection of the Land and the Sea** for public procurement in the building industry (soon to be issued also for the road construction industry).

Indeed, Matrix® incorporates the most advanced voluntary technical standards relating to environmental aspects, as specifically required under CAM: the Environmental Product Declaration (EPD®), presenting comprehensive information on the environmental impacts identified through the Life Cycle Assessment (LCA), and Product Certification under the Remade in Italy scheme.

This is why the use of the Matrix® Family products helps achieving the highest scores in terms of recycled materials in calls for tenders.



# MATRIX® FAMILY APPLICATIONS IN THE BUILDING AND INFRASTRUCTURE INDUSTRIES

The Matrix® Family products have wide-ranging applications as a replacement of newly-extracted raw materials in a variety of cycles in the building industry. Below are the most popular applications, as used by leading Italian and international companies.

Use has been tried and tested, is based on awareness and can rely on precise directions.

## **Declaration of performance**

In accordance with the Construction Products Regulation (Regulation 305/2011/EC), all construction products covered by a harmonised technical standard must bear the CE marking and must obligatorily be accompanied by a Declaration of Performance (DoP), a key document indicating the name of the manufacturer and providing users with important information on technical and environmental performances.

Bearing the CE marking, as aggregates to be used in the production of concretes, bituminous conglomerates, mortars and cement-bound mixtures, the Matrix® products come with specific DoPs, providing comprehensive indications on use to final customers.

The standards that are currently met by our Factory Production Control Certificate are: UNI EN 12620, UI EN 13139, UNI EN 13043, UNI EN 13242.

## **DoP: maximum percentage of use and end of life for Matrix®**

In order to ensure awareness of use in relation to our products, the DoP indicates, sector by sector, the maximum percentage of Matrix® that can be used in replacement of natural sands and gravels. This ensures that 'MATRIX® Inside' products and conglomerates are fully compliant with the applicable technical standards and environmental recommendations, with particular reference to the leaching test. Not only that: at the end of their life cycle, these products can be automatically reintroduced into the virtuous cycle of recovery of construction and demolition waste.

## **CEMENT CLINKER**

MATRIX® is used, in partial replacement of newly-extracted raw materials, as a component of the meal that is cooked in the cement plant kilns for the production of clinker.

Having already undergone a firing process and partial decarbonation, Matrix® is valued for its environmental credentials. Indeed, in addition to ensuring remarkable savings in terms of newly-extracted raw materials, it also significantly contributes to reducing the amount of CO<sub>2</sub> released during the process. Calculations show a reduction of CO<sub>2</sub> between 100 and 150 kg per tonne of Matrix® used in a cement factory in replacement of 1 tonne of natural marl equivalent.



From a technical viewpoint, Matrix® is used as a silica-containing material for the adjustment of meals that are too rich in lime and for its flux content (in particular aluminium and iron oxides) or, simply, as an addition to natural marl, of which it imitates the composition, albeit with a lower lime content and a higher silica content.

REACH registration is a mandatory requirement for use in cement production.

## PREMIXED CONCRETE

Premixed concrete is a conglomerate that is obtained by mixing (normally with the addition of additives) cement, large and fine aggregate (gravel, grit, sand) and water.

**AGMATRIX®** is used in premixed concrete as a replacement of natural grit by leading domestic manufacturers.

**AGMATRIX®** carries the CE marking under standard UNI EN 12620, level of attestation of conformity 2+, which is compulsory for use in structural concrete. A closely-linked sector to concrete is that of cement-bound mixtures for road construction. **AGMATRIX®** and **SandMatrix® 0-4 mm**, (both bearing the CE marking under standard UNI EN 13242) can be used successfully in this field.

## CONCRETE PRODUCTS

In this sector - comprising products such as concrete anti-slip blocks in all shapes, lane dividers, aggregate concrete blocks, etc. - both **AGMATRIX®** and **SandMatrix®** are successfully used as aggregates in replacement of sand, in grain sizes 0-4 mm and 2-4 mm.

## BRICK BLOCKS

The main raw materials used for the production of brick blocks are clay, aggregates and organic fillers and stuffers (sawdust, polystyrene, perlite, etc.). When clay is too plastic, sand-type aggregates need to be added to the mixture so as to diminish water requirements and thus reduce shrinking during the drying and firing phases. A study conducted with the cooperation of the Centro Ceramico di Bologna (Bologna Ceramic Centre) has shown that **SandMatrix® 0-2 mm** is particularly suitable to be used as a filler to reduce the quantity of natural sands used in the brick-making industry.

## CERAMIC

A cooperation between Officina dell'Ambiente, the University of Modena and Reggio Emilia and a leading manufacturer in the Sassuolo district has shown that Matrix® can be successfully used as a replacement of feldspar in glazed technical porcelain stoneware. With the necessary technological adjustments, it is possible to replace high percentages of feldspar, with no effect on the mechanical and aesthetical properties of the final product.

## BITUMINOUS CONGLOMERATE

Bituminous conglomerate is an artificial mix consisting of a variety of aggregates and a bituminous binder. It is generally employed in the construction of drivable surfaces (roads, runways, etc). Aggregates are normally sand, grit and gravel extracted from quarries or deriving from the crushing of rocks. SandMatrix® can be used as an industrial fine aggregate, in partial replacement of natural sands in the making of the base, intermediate (binder) and surface layers of bituminous conglomerate.

Numerous studies entrusted to leading materials testing laboratories (accredited with the Italian Supreme Council of Public Works) on the possible use of SandMatrix® in this sector have shown that the requirements set out in the general specifications laid down by ANAS (the Italian state-owned company entrusted with the management of roads of national interest) are met.

In recent years, **SandMatrix®, in its 2-4 mm grain size**, has found an excellent application as recycled sand for the production of cold-laying bitumen: a special product, normally sold in bags, that is used for the repair of potholes on the road surface.

## PREMIXED MORTARS

A constantly-growing sector, in which the product **SandMatrix® 0-2 mm** - carrying the necessary CE marking as required in accordance with standard UNI EN 13139 (Aggregates for Mortar) - is used. SandMatrix® is used as partial replacement of natural sands for the production of pre-mixed mortars in bags (both standard and fibre-reinforced).





# MATRIX® FOR LEED® AND BREEAM

In the field of Green Building and the sustainable certification of buildings, relating to privately-owned construction projects, the LEED® and BREEAM protocols obligatorily require the use of products with an approved and certified recycled content.

For the above reason, the Matrix® Family products are perfect to obtain credits for the LEED® and BREEAM certifications, the most important energy and environmental performance voluntary assessment systems for buildings. Used extensively all over the world, these schemes promote a sustainability-oriented approach, recognising the virtuous performance of buildings in terms of energy and water savings, reduction of CO2 emissions, improvement of environmental quality of interiors, materials and resources employed, from the type of project to the choice of site.

In a nutshell, Matrix®, responding to the LEED® and BREEAM requirements, is still one of just a few manmade aggregates in Europe to have obtained the EPD® certification, thus boasting the highest environmental credentials for maximising credits in the Materials and Resources category - V3 and V4 versions.

A 100%-recycled product that remains fully sustainable throughout its life cycle and has been designed to minimise the environmental impacts of its use and ensure maximum environmental and operational safety in the construction industry, for which it has been thought.

Officina dell'Ambiente is an active member of the Green Building Council Italia, for the promotion of sustainability in the building and road infrastructure industries.

([www.usgbc.org](http://www.usgbc.org) - [www.gbccitalia.org](http://www.gbccitalia.org) - [www.breeam.org](http://www.breeam.org))

## LEED®v4.1

Also thanks to their EPD®, the Matrix® Family products can be used to contribute to the achievement of the following credits in the Materials and Resources section of the LEED®v4 protocol:

### MRc2

#### ENVIRONMENTAL PRODUCT DECLARATIONS

To reward project teams for selecting products from manufacturers who have verified improved environmental life-cycle impacts.

#### 1 TO 2 POINTS

##### Option 1

AGMatrix® and SandMatrix® are EPD®-certified and can therefore be used to contribute to the achievement of the 20 EPD®-certified products required under this credit;

##### Option 2

AGMatrix® and SandMatrix® - for which a reduction of environmental impacts below the industrial average has been proven in at least three of the following categories - can be valued at 100% of their cost:

- Global warming potential;
- Depletion of stratospheric ozone layer;
- Acidification of land and water sources;
- Eutrophication;
- Formation of tropospheric ozone;
- Depletion of non-renewable energy resources.

In addition, for projects located within 160 km from the production site in Lomello, the same products can be valued at 200% of their cost.

The use of AGMatrix® and SandMatrix® as ingredients for the production of building products contributes and simplifies the LCA assessment of products and the achievement of the EPD® Certification.

### MRc3

#### SOURCING OF RAW MATERIALS

Promote the use of responsibly-extracted or sourced products.

#### 1 POINT

##### Option 1

All products in the Matrix® Family can be valued at 100% of their cost as post-consumer recycled content; in addition, for projects located within 160 km from the production site in Lomello, they can be valued at 200% of their cost.

The use of the Matrix® Family products as ingredients for the production of building products contributes to increasing the recycled content of said products.

**NEW**  
CONSTRUCTION  
AND MAJOR RENOVATIONS

**CORE AND SHELL**  
DEVELOPMENT

**COMMERCIAL INTERIORS**

**EXISTING BUILDINGS**  
OPERATIONS AND MAINTENANCE

**RETAIL:**  
NEW CONSTRUCTION  
AND MAJOR RENOVATIONS

**SCHOOLS**

**HOMES**

**NEIGHBORHOOD DEVELOPMENT**

**HEALTHCARE**



## MRc4

### MATERIAL INGREDIENTS

To reward project teams for selecting products for which the ingredients in the product are inventoried using an accepted methodology and for selecting products which minimise the use and generation of harmful substances.

#### 1 POINT

##### Option 1

All products in the Matrix® Family have safety datasheets listing their ingredients together with their CAS numbers and can therefore be used to contribute to the achievement of the 20 products with a chemical inventory; in addition, for projects located within 160 miles from the production site in Lomello, they can be valued at 200% of their cost.

## MRc1

### BUILDING LIFE-CYCLE IMPACT REDUCTION

To optimize the environmental performance of products and materials.

#### 1 POINT

AGMatrix® and SandMatrix® are EPD®-certified and their use contributes to simplifying the LCA assessment of buildings.



# EXCELLENCE IN LEED® AND GREEN BUILDING APPLICATIONS

## 1 PORTA NUOVA GARIBALDI

### CERTIFICATION

LEED® v2.0 Core&Shell

### CONSTRUCTION MATERIALS

Concrete blocks,  
lightweight screeds



## 2 PORTA NUOVA VARESINE

### CERTIFICATION

LEED® v2.0 Core&Shell

### CONSTRUCTION MATERIALS

Lightweight screeds



## 3 PORTA NUOVA ISOLA

### CERTIFICATION

LEED® v2.2 NC;  
LEED® v2.0 Core&Shell

### CONSTRUCTION MATERIALS

Cement conglomerate for  
non-reinforced foundations  
(cement) and concret





## 4 ISOZAKI TORRE CITY LIFE

### CERTIFICATION

LEED® 2009 Core&Shell

### CONSTRUCTION MATERIALS

Cement conglomerate for reinforced structural works



## 5 SAINT-GOBAIN SHOWROOM AND TRAINING CENTRE

### CERTIFICATION

LEED® Italia 2009

### CONSTRUCTION MATERIALS

Testing of Matrix®



## 6 'LA SERENISSIMA' BUILDING BLOCK

Via Turati 25/27

### CERTIFICATION

LEED® Italia 2009

### CONSTRUCTION MATERIALS

VIBECO concrete blocks



## 7 BUILDING BLOCK AT VIALE CERTOSA

144

### CERTIFICATION

LEED® Italia 2009

### CONSTRUCTION MATERIALS

Italcementi cement  
PAVER concrete blocks



# TEST FIELDS

FOR SAND MATRIX APPLICATION

Italian Highway





**EMAS**

GESTIONE AMBIENTALE  
VERIFICATA  
reg. n. I-000555



CERTIFIED ENVIRONMENTAL PRODUCT DECLARATION  
S-P-00427 [www.emimondoc.com](http://www.emimondoc.com)



### Officina dell' Ambiente S.p.A.

REGISTERED OFFICE Via Mario Pagano 46 - 20145 Milano

P.IVA 13196590155

### Lomello Production Site

Strada Provinciale 193 bis - Tenuta Grua - 27034 - Lomello (PV)

Tel. (+39) 0384 85250 - Fax. (+39) 0384 85432

### Conselice Production Site

Via Selice 301/E 48017 - Conselice (RA)

Tel. (+39) 0545 986080 - Fax. (+39) 0545 986487

[info@matrixoda.it](mailto:info@matrixoda.it)

[www.matrixoda.it](http://www.matrixoda.it)

