
ARC
INNOVATIONS

ARC Innovations develops, produces and markets eco-innovative products and technologies via pioneering initiatives, groundbreaking reseARCh and inventive, but practical solutions.

About

ARC Innovations provides solutions inspired by cutting edge reseARCh and technologies for eco-innovative products.

ARC develops, produces, commercialises and represents, and then markets these solutions for and to players predominantly in the construction industry.

The company's primary focus is the development of composite cement with the lowest possible carbon footprint and commercialising hybrid cements. ARC also develops and commercialises a range of additional eco-solutions for the built environment and industry at large.

ARC Innovations' role is and will continue to be that of an environmental steward that inspires increased responsibility and innovation in the field.

By looking forward, ARC is able to provide solutions for today and most importantly, for the future.

ARC is based in South Africa, servicing clients and partners both locally and abroad.

Vision & Mission

ARC Innovations' vision is to establish itself as the leader in the development, production and marketing of eco-innovative industry solutions, by actively seeking out sustainable alternatives to traditional materials and thereby challenge traditional paradigms. The mission to achieve this centres around key objectives:

- Maximising the use of waste materials in the production processes in the interests of reducing costs and environmental responsibility
- Capitalising on the knowledge base that focuses on developing alternative materials and solutions for the construction industry
- Actively using internal skills and resources to educate local communities on environmental matters and further develop and encourage related employment opportunities

Expertise

ARC Innovations' strengths and expertise lie in our extensive understanding of the sustainable built environment and commercialisation of products in this market.

By marrying this knowledge of construction and construction materials with innovative concrete technology, ARC is able to provide a viable alternative in a changing environment that is competitively-priced and has significantly lower impact on the environment than the traditional, price-sensitive and commoditised products currently available.

ARC Innovations offers products and services that are:

- Responsive to customer needs
- Agile and alert to the changing variables within industry
- Innovative, sustainable, and optimal when it comes to waste
- Practical solutions that benefit the client and the environment

All our clients are well established manufacturing and construction giants who already possess the infrastructure required to exploit ARC Technology to its fullest.

We work with:

Murray & Roberts

Steffanuti and Stocks

SANRAL (South African National Roads Agency)

ARC Achievements

Gautrain design and production of concrete (32% substitution of cement with PFA)

Transnet City Deep Container Terminal: First application of 100% Portland cement replacement concrete in South Africa on 9 Dec 2013

2014 Runner-up for the Nedbank Sustainability Awards for the Transnet City Deep Container Terminal

Featured Product
Hybrid Cement

About

ARC Innovations was founded with the objective of pushing the limits of alternate solutions for the challenge of sustainable construction via the production of composite cements.

The development, commercialisation, and ultimately the use of hybrid cement technology provides for a far more sustainable and environmentally responsible process with the potential to replace traditional and widely-used cement.

Hybrids are a type of inorganic polymer that can be formed at room temperature by using industrial waste or by-products as source materials to form a solid binder that looks like and performs a similar function to normal cement.

Hybrid binders can be used in applications to fully or partially replace cement with important environmental, technical and cost benefits – including an 80 - 90% reduction in CO_2 emissions and improved resistance to fire and aggressive chemicals.

Hybrid cement is made from aluminium and silicon, instead of calcium and silicon. The sources of aluminium in nature are not present as carbonates and therefore, when made active for use as cement, do not release vast quantities of CO_2.

Benefits

With only a few additional requirements, placing hybrid concrete is very similar to placing traditional cement concrete, which means any conventional concrete crew is able to place it without additional training or expensive equipment.

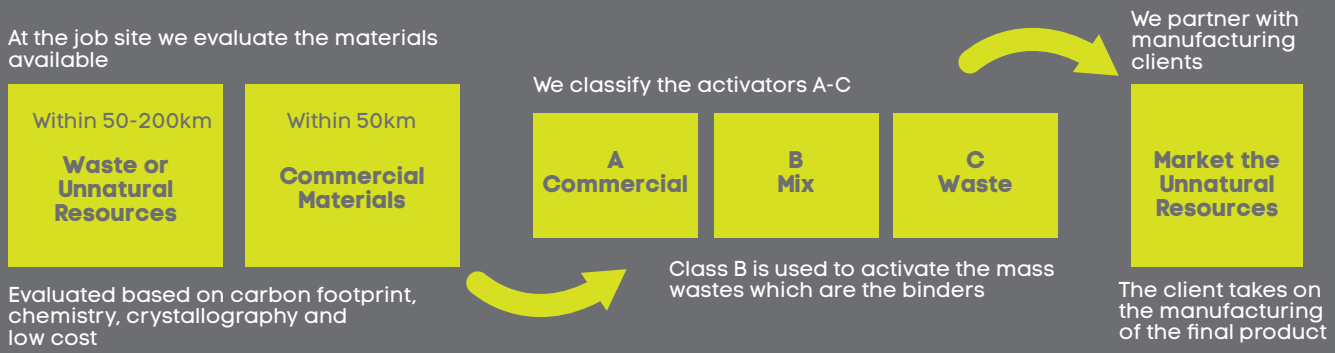
Other benefits include:

- The engineering and construction properties of hybrid cement, when used to make concrete, have been repeatedly and independently shown to be equivalent or better than traditional cements.
- Hybrid cement exceeds traditional cement performance specifications in areas such as chemical or salt resistance and fire resistance. Its fire resistance has been tested to be well over twice that of traditional concrete which has distinct technical benefits, particularly in high-rise construction buildings.
- Hybrid cement has a far lower carbon footprint, produces fewer cracks, is more resistant to corrosive elements such as sea salt, offers excellent frost resistance and durability in cold climates, and is available with rapid setting binders available.
- Porous hybrid cement is light weight, easy to work with and insulating. No additional insulation is needed.
- Recycled waste materials can be used to make hybrid cement, thereby making the material 80 - 90% more carbon neutral.

Design Process

The design process allows for large economic and environmental saving for the materials applied in standard building practice.

The concrete is tested with high percentages of waste or by-product using ARC technology which leads to massive reductions in the Portland cement content for structural concrete.



The main process difference between traditionally used cement and hybrid cement is that normal cement relies on a high-energy manufacturing process that imparts high potential energy to the material via calcination. This means the activated material will react readily with a low energy material such as water.

On the other hand, hybrid cement uses very low energy materials, like Fly Ashes, Slags and other industrial wastes and a small amount of chemical activators which may be in the form of neutral salts or alkali and acidic activators, or specific combinations of the above to bring about reaction at the surfaces of particles to act as a glue.

This approach allows the use of measured amounts of chemicals to tailor the product to a particular specification, rather than using an amount of very high-energy material, regardless of whether the material is used to build strength.

This approach results in a very large energy saving in the production of hybrid cement, amongst other benefits.

Winning with ARC Technology

The Gautrain was one of the largest infrastructure projects in the world in 2008 using over 1000000m^3 of concrete. The original estimates for cement usage was 344 000t of Portland cement, with applying ARC technology to the project we reduced the amount used on site to approximately 210 000t of Portland cement while replacing the difference with the by-product/waste from coal-fired power station, Lethabo.

Countering the carbon dioxide emitted from producing 344 000t of Portland cement would require a rain forest of 4.5 x 3.5 km alive for 40 years, due to the unnatural resource replacement through ARC technology this was reduced to 2.5 x 3.5km required. With compressive strengths 75% higher than expected when compared to standard concrete technology.

Global Impact

The standard Portland cement replacement with SCM's is approximately 15 - 30% worldwide.

Due to early strength requirements for buildings, SCM's generally only constitute 15 - 20% of the binder content in concrete.

The costs to customers amount to a fraction of their economical savings.

We provide the technology and design on a royalty basis, for a monthly fee which could range from 35% based on sales.

Featured Product Hybrid Cement - Continued

Product Offering

ARC Innovations offers a range of services and products that are all driven by eco-innovation that provide solutions to, in particular, the construction industry.

Bagged cement (Variant 1)

Up to 80% Portland cement replacement with Pulverised Fuel Ash (PFA), while maintaining setting times of a 100% Portland cement material and achieving the required compressive strengths of 32.5 or 42.5 categories as per SANS 501971-.

Bagged cement (Variant 2)

Up to 95% Portland cement replacement with Ground Granulated Blast Furnace Slag (GGBS), while maintaining setting times of a 100% Portland cement material and achieving the required compressive strengths of 32.5 or 42.5 categories as per SANS 501971-.

Premix products utilising recycled materials for the retail market

Up to 100% replacement of conventional Portland or alumina cements with eco-binders based on zero carbon emission material to produce flowable bearing grouts, repair mortars and screeds.

Trade of carbon credits

To equip clients with carbon emission savings to offset carbon tax in the production of binders and construction materials such as bricks, grouts and screeds.

Radioactive absorption

Produce eco-concretes and eco-grouts with sufficient pseudo-zeolites to alter the hardened state properties to absorb nuclear radiation and particles.

Hydrocarbon consumption

An organic based system that can absorb hydrocarbon spillage and produce edible fruit within a few weeks. Ideally suited for industrial and commercial sites that could have petrol, oil or diesel spillage.

Road stabilisation (Variant 1)

An organic based system that uses mechanical stabilisation which is enhanced with exposure to environmental elements. Standard chemically stabilised roads using cementitious materials are compromised when exposed to water as they are diluted and eventually washed away resulting in potholes and road degradation.

Road stabilisation (Variant 2)

An alternate zero carbon emission based eco-binder which binds subgrades according to chemical stabilisation.

Control-set cement

Setting of cementitious materials can be controlled to achieve quick setting or retardation with the benefits associated with either.

Refractory cements

Heat resistant concretes and linings can be produced while using the eco-binders with good insulation properties.

Product Offering - Continued

Industry and Market

As we strive for economic growth, there is no doubt that an increase in the demand for cement and other building materials is always at the core of that development. While there are obvious benefits, this also comes with its fair share of challenges.

Over the years, there have been unprecedented pressures and damage to our natural environments. Activities such as mining, manufacturing, processing, transportation and consumption not only deplete the stock of natural resources but also add stress to the environmental systems.

Unfortunately, a significant portion of environmental damage tends to be irreversible and has huge social and economic cost implications.

Importantly, there have been calls for sustainable construction methods, with industry groups around the world adopting different sustainable initiatives. These approaches range from pushing for reform to international building codes, to finding alternative solutions to traditional building methods and materials.

Green manufacturing calls for the preservation of natural resources and the reduction and where possible, the elimination of harmful pollutants released into the atmosphere, especially CO_2.

The cement industry, for one, has focused on the production process to reduce the use of natural resources. The increased production of composite cements, also known as blended or extended cements in other parts of the world, is evidence of the growing willingness by the industry to make responsible decisions. Technological advancements have allowed cement manufacturers the luxury of using alternative materials that possess cementitious properties and have a low carbon footprint in the cement making process.

In South Africa, composite cements have to conform to the SANS 501971- specification for common cements and can only be sold after obtaining a regulatory letter of authority which indicates compliance.

At this point, the cement industry's best answer to its impact on the environment and the growing calls for sustainable construction is the production of composite cements, such as hybrid cement.

1. Cement production accounts for approximately 8% of global emissions with 1 kg of Portland cement/clinker approximately equivalent to 1 kg of carbon dioxide emitted.

2. ARC believes jobs can be created close to areas of high waste dumping sites which have generally been an area of high density, low skill and low financial stability. Mine slimes can be used as the base for material for brick/block and roof tile manufacture. This material can also be used to construct roads in these areas where transport is a hurdle currently after every rainstorm to facilitate transport to school, work or clinics. The reduction of costs in the materials would hopefully have the effect that more infrastructure be built in a shorter time period to benefit the low income households.

3. We want to use ARC technology to influence the world to reduce the impact of Portland cement manufacture from the current 8% of global emissions to 6% or lower.

Case Study 1

Case Study 1: Transnet City Deep Container Terminal 2014

On September 13, 2013, the first commercial and industrial 0% Portland cement concrete was cast in South Africa at the Transnet City Deep Container Terminal.

Three large test sections were cast to review the longer term durability, compressive strengths and abrasion resistance. The 0% Portland cement exceeded all specifications and out-performed the Portland cement concrete.

The standard 50MPa concrete on the project has up to 70% of the Portland cement replaced with Pulverized Fuel Ash (PFA). All 77 000m^3 of the old paving concrete was recycled as G5 material on the project and the small excess was sold through a BEE SME. This is the only project in South Africa to have recycled all 100% of its old concrete.

Murray & Roberts was awarded 2nd place in the 2014 Nedbank Sustainability Awards due to the ARC technology applied on this project.

Based on the original concrete designs with 35% replacement of Portland cement with PFA:

- Reduction of 35% of carbon footprint related to all materials for concrete
- On award, an estimated concrete material CO_2 equivalence of 18 782 610 kg
- On as-built, through application of ARC technology, final estimated concrete CO_2 equivalence of 12 196 030 kg.
- Total saving of 6 586 580 kg of CO_2
- Economical saving of R6.8M, increase of profit of 8.33% on concrete
- Further to this, the project specification required a minimum of 24% of the old concrete to be removed and recycled, Murray & Roberts were able to recycle 100% of this material while increasing the profits by approximately R15M
- Total concrete 78 000m^3

Case Study 2

Case Study 2: Loeriesfontein Wind Farm

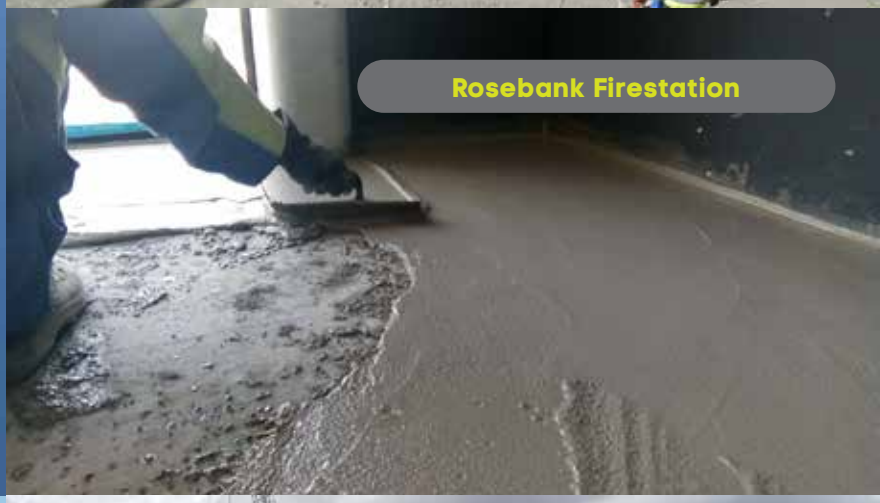
With using ARC technology, Murray & Roberts were able to use a water with high sulphates and nitrates as mixing water for the concrete. This water would have been considered inadequate as it is not potable and the water would have to have been transported from approximately 100km away from site, Loeriesfontein is in the desert. Over the 18 months of construction, approximately 15 730 kilolitres of water would have been transported via tanker which equates to 4 loads of 10 ton water bowsers per working day travelling 200km for the 18 month period.

Based on 35% : 65% ratio of PFA : Portland cement at Noupoort Wind Farm also designed through ARC technology:

- Reduction of 30.5% of carbon footprint related to all materials for concrete
- On award, an estimated concrete material CO_2 equivalence of 2 472 324 kg, based on 35% : 65% ratio of PFA : Portland cement at Noupoort Wind Farm also designed by ARC technology
- On as-built, through application of ARC technology, final estimated concrete material CO_2 equivalence of 1 717 948 kg.
- Total saving of 754 376 kg of CO_2
- Economical saving of R4.8M, Increase of profit of 7.4%
- Total concrete 65 000m^3


Jeffereys Bay Wind Farm


De Aar Wind Farm


Rosebank Firestation


Dishaba Mine


Noupoort Wind Farm


Loeriesfontein Wind Farm


Transnet City Deep Container Terminal

Hybrid Concrete: Advances in Concrete Activation

Addendum A features a study conducted by Cyril N. Atwell that explores the distinct advantages of hybrid concrete based on results gathered from practical application of the products in three separate construction sites in Southern Africa since 2010.

These advantages include:

- Lower costs environmentally
- Lower costs economically
- Better abrasion resistance
- Lower heat of hydration
- Crystalline formations in lieu of amorphous gels

The study introduces the schools of academic research related to the products, presents the methods and tests conducted on the site specimen, and explores the results gathered via data that is further extrapolated upon in a discussion that follows.

Key to the study is the conclusion that draws attention to the indication that the products have “a strong and durable matrix with no deterioration” in the environment they were exposed to.

The study and data can be read in full in Addendum A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