Promat Technology Trends

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Promat's Range Of PROMATECT® 50 Boards Awarded GREEN Label Certification In Singapore

Many products, directly or indirectly, either in their manufacturing processes, usage or disposal have varying degrees of impact on the environment.

Many cause pollution at some point of their lifecycle, others deplete precious, increasingly scarce natural resources. Some even exacerbate unsustainable business practices.

041-009

continued on page 3

Risk of concrete cracking under fire jeopardises construction integrity and fire safety protection criteria, potentially endangers all tunnel users.

PTT-KNOW-HOW

New Research Examines Phenomenon Of Cracking In Concrete Under Fire

The way most types of concrete behave in fire situations is a well-researched subject in the continuing, professional study of fire and fire science technologies.

It depends on a numerous factors including the type of concrete, the structure's design function, structural components and of course the location and type of fire.

Indeed, concrete offers great fire resistance to structures and provides reasonable physical stability up to about 550°C. Even above that temperature it does not fail dramatically.

Furthermore, concrete's thermal properties protect reinforcing steel and pre-stressing steel, and it does not fall off structural steel members like some fire protection materials are known to do.

Concrete's excellent performance in fire is due to its main constituent materials – cement, water and aggregates – which, when combined, form a strong material that is non-combustible and has a thermal conductivity equal to approximately 1/21 that of steel.

It is this slow rate of heat transfer that enables concrete to act as an effective fire shield, not only between adjacent spaces but also in protecting reinforcing bars and internal concrete from damage.

The nature of concrete-based structures therefore means that they generally perform very well in fire. However, a good report card for versatile concrete does not mean that it is not adversely affected by fire or heat.

Most products of Portland cement hydration are to a large degree physically stable (despite some shrinkage) to the 500°C level. Some are not.

For example, Ettringite, normally a minor component of concrete, can decompose below the 100°C boiling point of water. This usually occurs without deleterious effects because Ettringite is present in only small amounts. In fact, the water evolved tends to lower temperatures within the concrete.

Understanding The Need To Protect Concrete, Especially In Tunnels

The need for protecting concrete against the ravages of fire has been understood for many years. It has developed into an important worldwide industry in which Promat's ongoing Research & Development programme and accumulated expertise in tunnel protection are considered benchmarks by many.

When the Rijkswaterstaat, an executive agency of the Dutch Ministry of Transportation and Water Management, published its Rijkswaterstaat (RWS) Time Temperature Curve in 1979 it marked the realisation that fire in tunnels was not the same as fires within buildings.

	Pore pressure due to evaporation of moisture	Compres-sion due to thermal gradient	Internal cracking due to different thermal expansion of aggregate-cement paste	Cracking due to different thermal deformation of concrete-steel	Strength loss due to chemical transitions
Violent spalling	✓	✓	✓		
Sloughing off			✓		✓
Corner spalling				✓	
Explosive spalling	✓	✓			
Post-cooling spalling			✓		✓

Above: Summary of the relationships between type of concrete spalling and spalling phenomena.

The RWS curve is based on engineering assumptions and describes the temperature-time relationship of a fire in a tunnel with petrol leaking out of a tanker.

Its accompanying design method was based on insulating concrete to increase the time it took for concrete to reach temperatures above 380°C by applying fire protective materials.

continued on page 2

NEW RESEARCH EXAMINES PHENOMENON OF CRACKING IN CONCRETE UNDER FIRE

continued from page 1

Tunnel fire caused by fuel oil can reach temperatures in excess of 1000°C in just a few minutes. The conflagration may last for several hours and obviously have a detrimental effect on the tunnel construction.

New Research Also Looks At Significance Of Deformation And Leakage

It is also now recognised that standard modelling techniques in current use for determining fire performance of concrete structures cannot predict the level of cracking that can occur within structures.

A study performed by TNO (Netherlands) in 2004 looked at the issue of repairing concrete exposed to fires within tunnel environments. Particularly close attention was given to the possibility of permanent damage occurring to constructions in terms of deformation and cracks which could in turn result in leakage (in immersed tunnels), thereby leading to corrosion of structural reinforcement.

The TNO report concluded that although deformation may be negligible, and cracks tend not to form on the exposed face of the concrete structure, there was a distinct possibility that cracking could occur on the unexposed face of the structure. This is believed to be due at least in part to thermal incompatibility across the thickness of the structures.

The Finite element simulations used at the time were inadequate in detailing this aspect of performance. The idea that cracks may develop on unexposed sections of the structure is nevertheless important because many cracks can neither be seen nor repaired when damage is assessed from within the tunnel.

In the other hand, the focus of fire safety engineering has moved in a different direction. As concrete mixtures become increasingly high grade, explosive spalling has become a major issue. When concrete is heated, moisture or water vapour will expand more than the surrounding concrete, and escape through the pores.

However, when permeability is small – typical of high grade concretes – water vapour cannot escape and internal pressure will build, eventually leading to explosive spalling of pieces of the concrete from the heated side.

A solution is found in the application of polypropylene (PP) fibres mixed through the concrete. These fibres melt at around 160°C, creating voids and channels through which water vapour escapes, alleviating the internal pressure. A growing number of people in the construction industry believe that PP fibres might well be an alternative to fire resistant boards or cementitious spray materials.

This in turn has increased the need for further research into the problem of cracking on the unheated side because, unlike fire resistant boards or sprays, the application of PP fibres does not insulate the structure nor reduce the heat gradient.

At temperatures of 1000°C or above, thermal incompatibility between the exposed and unexposed face of a concrete structure will become much larger, possibly causing far larger cracks on the unheated side.

A series of fire tests were also carried out on small scale immersed tunnel sections. Some sections were protected with PP fibres, others by fire resistant boards while some remained unprotected.

All sections were exposed to a range of heating rates to determine the ability of the concrete to withstand the effects of cracking.

In all tests of the uninsulated concrete, the cracking patterns were more or less the same on each occasion in terms of the global pattern and the location of the most severe cracking.

The development of crack width and the distance between cracks were variable. The largest cracks occurred near the junction between walls and soffit portion of the structure, possibly because the thermal gradient in the soffit section tends to bow towards the fire.

The complete article is available to download at http://www.promat-ap.com/ptt/ptt_jan-jun2009.htm. To do justice to the complex issues related to this new and important research, full report details are available from Promat or for download at http://efectis.com/nl_en/index.html ☐

The Eggs Of Diversity

The wisdom of the old proverb "Never Carry All Your Eggs In Just One Basket" has always been clear. If the basket fails, obviously all is lost!

While it's true Promat does focus a great deal of time and energy on one specialised niche – the innovation and application of advanced fire science technologies for better fire protection of the built environment – this target market in turn represents a wide, almost endless variety of inter-related business opportunity.

From the built environment to marine applications to high temperature insulation and many more beyond. This is the nature of fire risk.

Not surprisingly, Promat's conservative growth strategies linked in recent years to a policy of careful but deliberate diversification are not only helping to soften some of the harsh blows of the current economic downturn but also illuminate our path to the future.

In so doing, I also believe it is absolutely essential that we now borrow some of these ideas, adapt and apply them to other areas of our business. Not just geographical or product portfolio expansion but also how we personally and professional maximise our effort to improving bottom line results.

How we work together as a cohesive team is a very good example, despite or because of the geographic and cultural differences.

Controlling costs is vital too. On the other hand, how we increase efficiency and improve productivity is another matter entirely. Getting better at our jobs, training, education, increasing our knowledge across a broad spectrum of interrelated disciplines – optimising what we have – are all key to better performance, better profits.

To this end, we have a number of on-going programmes in place and the company's emphasis on technical seminars and the interchange of relevant information, all adding to Promat's reputation as The Knowledge Centre, will continue. Management is actively looking around the region for other opportunities which will benefit from *The Promat Way*.

In fact, this issue of PTT (Promat Technology Trends) reflects the concepts of diversification and professionalism in fire protection very clearly indeed.

We lead off on pages 1 and 2 of certain aspects of the performance of concrete in tunnels and tunnel fires is sure to answer many questions as it continues to build our reputation for world leading professional expertise.

On the important environmental front PTT takes a brief page 3 overview of the recent acquisition by Promat products in Singapore of Green Label Certification.

On other pages we feature stories of Promat products hard at work effectively protecting an automated stack-up car park at Singapore General Hospital and PROMATECT® 50 pipe riser projects on the busy island.

Promat Sprays Division's reputation as a leading player the field of fire protection in the hydrocarbon and petrochem industries is highlighted by an article on Cafco FENDOLITE® MII applications at a Petronas refinery in Malaysia. As we all know, many Petronas initiatives are highly visible on the global stage. Cafco SPRAYFILM® WB3 can also be seen hard at work in our Hong Kong International Airport flight maintenance facility story illustrated on page 4.

An overview of versatile PROMASIL® HTI (high temperature insulation) and flexible PROMAGUARD® microporous insulation round out this issue of PTT.

As I look around the fascinating Asia Pacific region we call home, I see the dynamics of diversity overcoming difficulties, solving business problems and resiliently turning to a better tomorrow.

It is never prudent to put all our eggs in one basket but the wisdom of diversifying our eggs across a number of different business disciplines, balance by sensible risk management strategies, will help us achieve our objectives. I believe this issue of PTT, a reliable source of quality technical and business information, reinforces Promat's status as an industry leader.

There are testing times ahead but I am optimistic. If we confront challenges together as a team, if we diversify our strengths sensibly, we will be well-positioned for anything the future holds in store.

Thank you for your valuable support, I look forward to continuing our work together.

Erik D. van Diffelen
Managing Director
Promat Asia Pacific Organisations
Second Quarter 2009

Promat's Range Of PROMATECT® 50 Boards Awarded GREEN Label Certification In Singapore

041-009

continued from page 1

Recognising that something had to be done and that every long journey begins with a single step forward, the Singapore Green Labelling Scheme (SGLS) was launched in 1992 and then administered by the Singapore Environment Council.

The main aim of the SGLS is to promote environmental awareness and to help consumers and businesses identify products that are environmentally friendly.

The SEC secretariat recommends product categories and solicits suggestions from industries, and vice versa. It also establishes the criteria that a product must comply with in order to gain certification under the Scheme and approves applications for Green Label certification.

The SGLS applies to most products, except food, drinks and pharmaceuticals. It does not apply to services and processes.

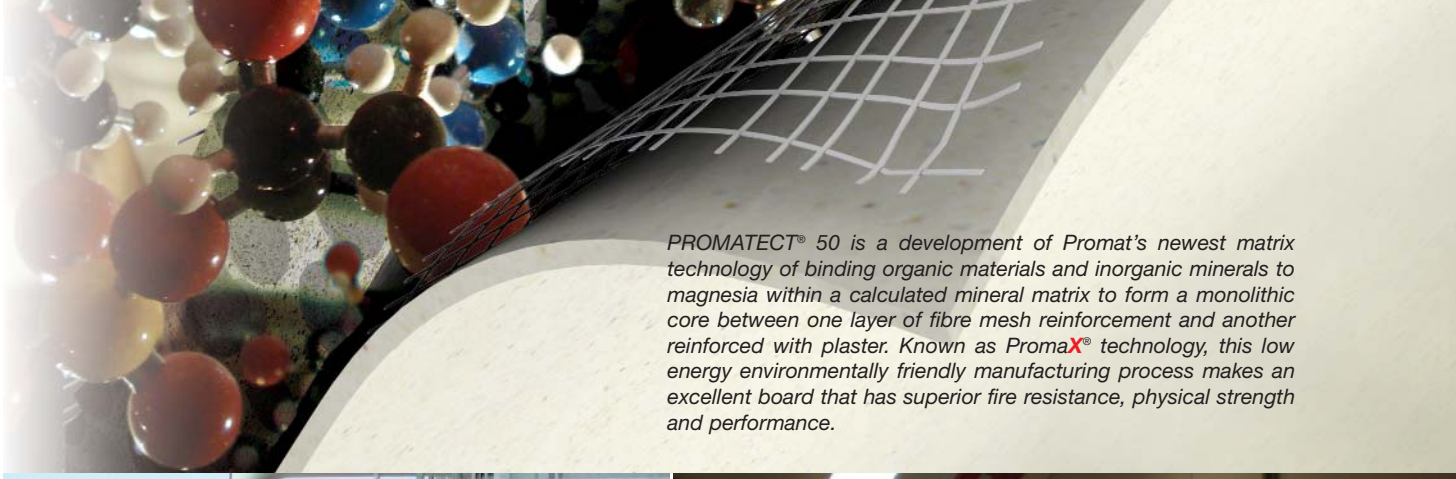
However, the Green Label can be used on products which meet the eco standards specified by the scheme. It is recognised as a member of the international Global Ecolabelling Network (GEN).

The criteria for Panel Boards/Wallboard (GLS-041), for example, is applicable to a range of panel board products, generally for indoor use such as interior paneling as well as use in further processed products.

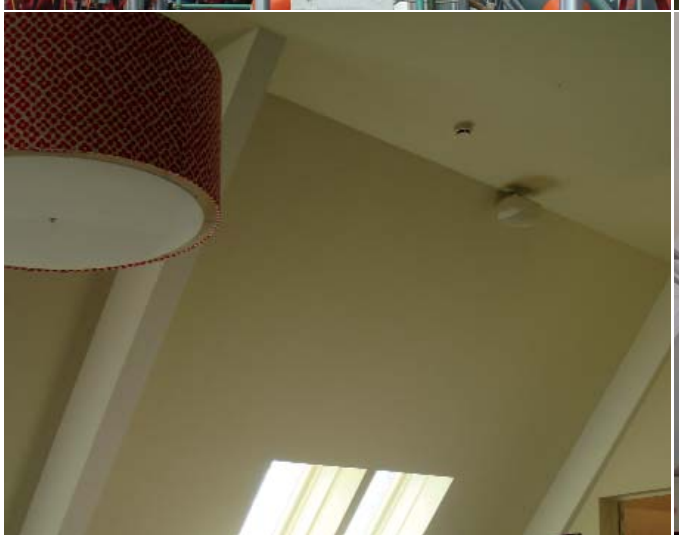
Promat Building System Pte Ltd recently applied for and, after all required test reports were approved by SEC, received SGLS certification for its range of PROMATECT® 50 boards.

This means that specifiers in Singapore can be confident that PROMATECT® 50 is fully compliant with the island republic's tough construction industry standards for environmentally friendly industry practice.

It should also be noted that Promat factories, products and companies worldwide subscribe to and sustain the highest environmental, health and safety standards that meet ISO 9001, ISO 18001 and most other internationally recognised standards. ☐



*PROMATECT® 50 is a development of Promat's newest matrix technology of binding organic materials and inorganic minerals to magnesia within a calculated mineral matrix to form a monolithic core between one layer of fibre mesh reinforcement and another reinforced with plaster. Known as Proma**X**® technology, this low energy environmentally friendly manufacturing process makes an excellent board that has superior fire resistance, physical strength and performance.*



To Achieve High Technical And Safety Standards, Malaysian Oil Refineries Select Hi-Tec Performance Of Cafco FENDOLITE® MII

Malaysian crude oil is extremely valuable, given its low sulphur content which makes it easier and less costly to refine. Exploiting new fields and developing additional sites are key components of the government's economic development strategy.

Natural gas plays a larger role in the nation's hydrocarbon sector than oil although the country's large output goes mainly to the domestic market, limiting its role as a major forex earner.

The country's robust hydrocarbon industry is managed by wholly government-owned Petronas, an acronym representing Petroliam National Berhad. It is a fully integrated oil and gas corporation consistently ranked among Fortune 500's largest corporations in the world. The company is globally well known for its international initiatives.

Strategic Refinery Investments On Both East And West Coasts Of Peninsula

Petronas owns and operates the Petronas Kertih Refinery through wholly-owned subsidiary Petronas Penapisan (Terengganu) Sdn Bhd. The refinery was the first Petronas refinery to be located in the northeast state of Terengganu.

It processes 40,000 barrels of Malaysian light, sweet crude per day and recently has been expanded to include a condensate splitting facility known as KR-2 with a rated capacity of 63,500 barrels per day of condensates.

The naphtha it produces is used as feedstock for the aromatics plant adjacent to the refinery.

In the historic state of Melaka, the Petronas Melaka Refinery Complex houses two refining trains.

The first, known as PSR-1, is owned and operated by Petronas Penapisan (Melaka) Sdn Bhd, a wholly-owned subsidiary of Petronas. The train has a capacity to process 100,000 barrels per day of Malaysian light, sweet crude and condensates.

The second PSR-2 train of the Melaka complex is owned by Malaysia Refinery Company Sdn Bhd, a joint venture between Petronas and US-based Conoco Phillips. It too has a daily processing capacity of 100,000 barrels.

High Petronas Technical Requirements Matched By Cafco's International Fire Protection Standards

To optimise security and safety, Cafco FENDOLITE® MII – a single pack factory controlled premix based on vermiculite and Portland cement – is employed by Petronas for fire protection applications at their various refineries where it fire protects steel support structures.

The spray protection was applied after the intended members were constructed but prior to installation of functional piping, cabling equipment and other similar obstructions.

During application, frequent random thickness measurements were carried out to ensure applied thickness were adequate. The final thickness was measured using an approved thickness gauge after a minimum of 48 hours curing time. ☐

Location
Petronas Kertih Refinery

Contractor
Mushtari Engineering

Consultant
Foster Wheeler E & C Malaysia

Applicator
Prostart Engineering (M) Sdn Bhd

Product
Cafco FENDOLITE® MII

New Maintenance Centre At Hong Kong International Airport Installs Cafco SPRAYFILM® WB3 For Global Standard Fire Protection

HKIA, or Chek Lap Kok Airport as it is colloquially known, is a strategically important regional trans-shipment centre, passenger hub and destination gateway for many points in mainland China and the rest of Asia.

The airport is one of the world's busiest, both in terms of international passengers and air cargo. In 2008 alone, HKIA handled 48.6 million passengers and 3.63 million tons of cargo shipments.

A 24/7 Quality Centre Focused On The Future

Some 85 international airlines provide about 800 scheduled passenger and all-cargo flights each day between Hong Kong and more than 150 destinations worldwide.

HKIA also receives an average of approximately 31 non-scheduled passenger and cargo flights each week. All in all, the total computes to some 301,000 aircraft movements annually. HKIA's passenger capacity is currently pegged at 45,000,000 passengers but this can be expanded to an ultimate of 87,000,000 passengers.

Similarly, current cargo capacity is estimated to be three million tonnes but authorities believe HKIA can handle an ultimate of nine million tonnes in the future.

Traditions Of Excellence In Aeronautical Engineering And Maintenance

The Hong Kong aero-industry has a long tradition of excellence in aircraft engineering and maintenance. With so many airlines visiting the territory, aeronautical engineering is a big and economically significant business.

Despite the economic doldrums afflicting the region at the moment, HKIA is a continuing work in progress, its vision clearly focused on the future. A very good example of this flexible approach to business success is the recently built China Aircraft Services Ltd (CASL) maintenance hangar and workshop, located within the HKIA complex.

This new ultra-modern facility allows CASL to conduct professional state-of-the-art base maintenance activities including aircraft maintenance, repair and overhaul services.

Under a design and construct contract, the local office of lead consultant Scott Wilson provided structural, civil and geotechnical engineering services, and managed the architectural and mechanical and engineering inputs for the construction of the new CASL building.

The new two bay hangar is 110m x 91m in area with clear headroom of 22m/25m over a vertically two-tiered space.

Location
Hong Kong International / Chek Lap Kok Airport

Builder
China Aircraft Services Ltd

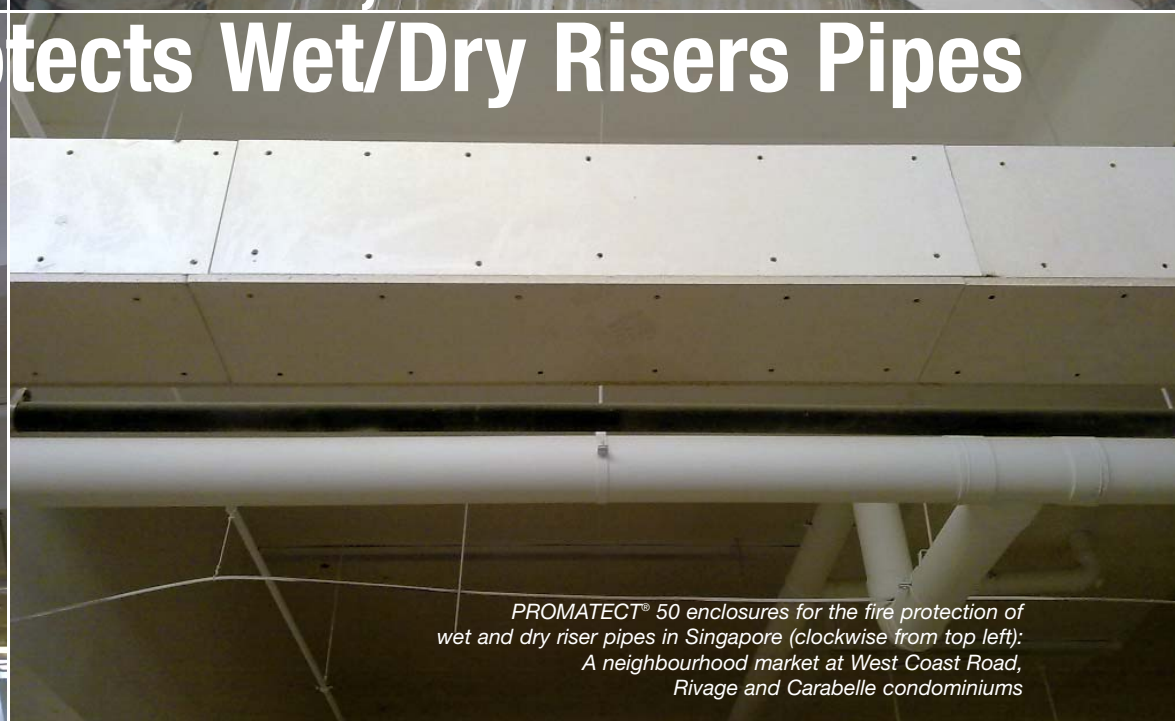
Consultant
Scott Wilson

Product
Cafco SPRAYFILM® WB3

The new CASL hangar is thus capable of accommodating one wide-body B747 or A330 aircraft and one narrow body B737 or A320 aircraft at any one time, allowing for multitasking and fast turnaround times.

To meet international standard fire codes, the new CASL building employs Cafco SPRAYFILM® WB3 over an application area of 3000m² of structural steel protection. ☐

WHITE and GREEN and CLEAN, PROMATECT® 50 Effectively Protects Wet/Dry Risers Pipes



PROMATECT® 50 enclosures for the fire protection of wet and dry riser pipes in Singapore (clockwise from top left): A neighbourhood market at West Coast Road, Rivage and Carabelle condominiums

Installer
Various Promat Appraised Specialist Scheme (PASS) members

Contractors
China Construction, Chiu Teng, Lum Chang, Sim Lian, S&L City Builders, TPS Construction, Woh Hup, etc

Product
PROMATECT® 50

Wet and dry riser pipes convey water to the entire fire fighting system of a building. Failure of such pipes during a fire event jeopardise the entire network.

Addressing this concern with considerable precision and foresight, the Singapore Fire Safety & Shelter Department requires such piping to be adequately protected against fire.

It is compulsory that such protection retains its performance criteria in a fire. Any collapse may effect water pressure, reducing and even negating the functionality of the sprinkler system. Protection systems for wet and dry riser pipes must prevent heat build-up in the pipe so that it does not reach the boiling point of water.

Any occurrence of these factors has the potential to devastate all fire fighting operations in a building and thus the structure itself.

PROMATECT® 50 is the latest product incorporating Promax® technology.

The Mineral Bound Magnesia board not only has excellent insulating properties to meet extreme temperatures but is also produced in a manner recognised and endorsed by Green Label Certification from the Singapore Environmental Council.

Supplied in modules to suit common diameters of wet and dry riser pipes, PROMATECT® 50 is quick and easy to install.

Since its recent launch, PROMATECT® 50 wet and dry riser protection has quickly become a firm favourite of local builders. In fact, some 20 projects have already installed PROMATECT® 50. These include several high quality private condominium projects such as Oceanfront on Sentosa, the republic's popular resort island, and the BOSCH Factory in suburban Bishan.

The Green Label awarded PROMATECT® 50 adds beneficial points to the Building and Construction Authority's Green Mark Score Scheme for the overall structure.

An additional bonus is that its white and clean surface requires no further painting or architectural finish. "White & Green & Clean" thus becomes a memorable and persuasive mantra synonymous with all things PROMATECT® 50. ☐

Effective Partnership:
PROMINA® 60 Works Hand-in-hand With Cafco SPRAYFILM® WB3 To Relieve Parking Woes In Hospital

"Maximise the plot ratio" is a familiar business mantra in land scarce Singapore, made more meaningful when a worsening economic downturn exacerbates already high construction costs.

The same principle is also the catalyst for numerous innovations in the science of "space engineering" on the crowded island city-state.

Singapore General Hospital is the oldest, largest and some say best hospital in the regional neighbourhood. Many specialist healthcare facilities are integrated into a single complex where parking is a serious constraint affecting visitors and patients alike.

Clearly, the new recently installed stack-up automated car park is a smart solution when a fast and easy way of adding parking lots is required. Both new parking facility and hospital alike benefit from the symbiotic partnership of PROMINA® 60 working with Cafco SPRAYFILM® WB3 fire protection.

PROMINA® 60 fire resistant internal lining provides 240 minutes fire protection, effectively segregating and compartmenting the car park structure from the adjacent hospital building.

Occupying a footprint of just four open car park lots, the stack-up car park building provides some relief with its additional 24 parking slots. The steel frame structure throughout is protected with Promat Cafco SPRAYFILM® WB3.

Cafco SPRAYFILM® WB3 is a water-based fire resistant coating providing 30 to 120 minute fire resistant loadbearing protection to structural steel.

Neither on or off-site spray application is detrimental to the environment.

Promat's total approach to proactive fire protection does much to enhance the quality of city living in Singapore. ☐

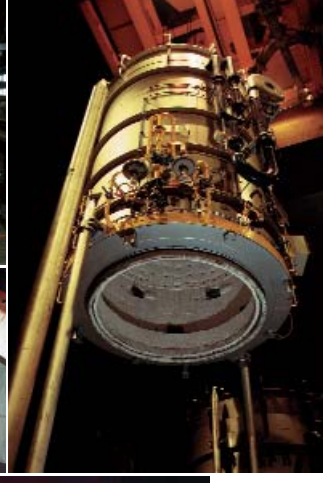
Location
Singapore General Hospital

Consultant
PKP Consultants & Zahidi AR Akitek

Installer
Current Pte Ltd / Innovente Pte Ltd

Product
PROMINA® 60, Cafco SPRAYFILM® WB3

Versatile, Lightweight PROMASIL® Looks Set To Increase Its Stake In The World Of Industrial HTI Applications



HTI is designed to provide optimum insulation in many high temperature applications, usually but not always industrial in nature.

These include facilities like smelters, machine and heavy plant engineering, induction furnaces as well as furnaces and dryers in general.

Promat's track record for the implementation of innovative ideas and solutions are second to none in HTI applications which range from 500°C to over 1600°C. Promat High Temperature Insulation protects everything from small refractory bricks to complete housings for dryers, machines and plant.

Promat has set benchmark standards for the HTI market for well over 40 years. Clients benefit not just from the accumulated know-how and all-round expertise but from the knowledge that existing products have been repeatedly and successfully tested over many years in many different types of applications.

New HTI products, when they come on stream, are the result of Promat's renowned and continuing Research & Development programme in which exhaustive field trials are a routine feature.

PROMASIL® 1000, PROMASIL® 1000P and PROMASIL® 1100 are lightweight calcium silicate insulating boards. They are asbestos free. In combination with lightweight refractory bricks or refractory concrete, these insulating boards are ideal construction material in re-lining.

Advantages and properties include low thermal conductivity, high thermal resistance, low thermal shrinkage, low bulk density, protective gas-resistant (CO, NH3, H2, N2 and CH4), free of sulphur and low in iron.

In modern production plants, the patented manufacturing process guarantees constant PROMASIL® quality above the requirements of ASTM and DIN standards.

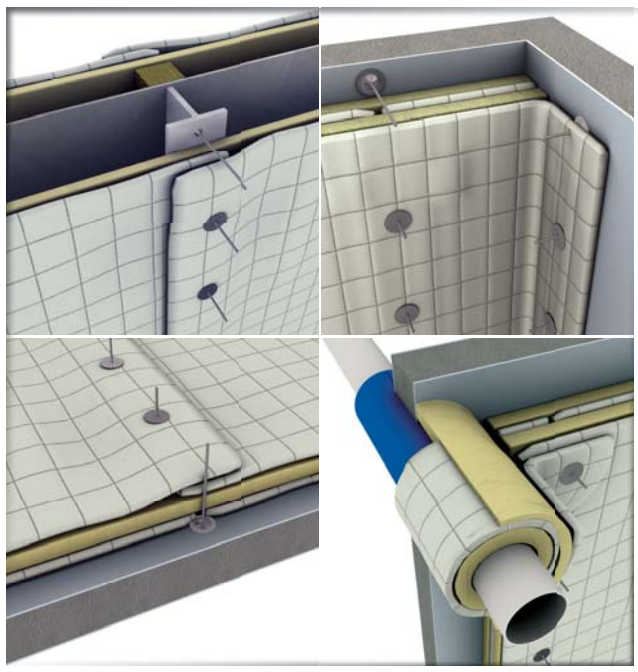
PROMASIL® 1000, PROMASIL® 1000P and PROMASIL® 1100 insulating boards and pipe sections are used in all industrial branches of refractory building for ambitious mechanical and thermal rear linings.

PROMASIL® can be found hard at work in:

1. Steel industry
   Smelting, heat distortion and heat-treatment plants
2. Ceramic industry
   Chamber and tunnel furnaces
3. Glass industry
   Melting furnaces and cooling channels
4. Cement industry
   Heat exchangers and cyclone separators
5. Chemical and petrochemical industry
   Thermal cracking reactors and processing plants ☐

Technical Properties

PROMASIL® range	1000	1000P	1100
Colour	White	White	White
Classified temperature	1000°C	1000°C	1100°C
Bulk density	245kg/m³	290kg/m³	285kg/m³
Compressive strength	1.4N/mm²	2.0N/mm²	1.9N/mm²
Shrinkage (1000°C, 12h)	1.3%	1.3%	1.5%
Thermal length change	5.4 x 10^{-6}m/mK	5.4 x 10^{-6}m/mK	5.5 x 10^{-6}m/mK
Specific heat	1.03kJ/kg K	1.03kJ/kg K	1.05kJ/kg K
Thermal conductivity 200°C	0.07W/m K	0.08W/m K	0.07W/m K
Thermal conductivity 400°C	0.10W/m K	0.10W/m K	0.10W/m K
Thermal conductivity 600°C	0.14W/m K	0.14W/m K	0.14W/m K
Thermal conductivity 800°C	0.17W/m K	0.17W/m K	0.18W/m K



Flexible PROMAGUARD® Microporous Insulation Set To Be The Prominent Fire Protection Standard Of Choice For Asia Pacific International Shipping Market

Saving space or rather optimising all available and valuable on-board space on sea going vessels, along with fundamental safety issues, is a major concern for all ship builders, operators and users alike.

These are the main reasons why the PROMAGUARD® range of fire resistant insulation products are gaining in popularity throughout the global marine world.

PROMAGUARD® is a flexible insulating panel comprised of a microporous core packed in a glass fabric and over-stitched with glass fibre monofilament.

It is manufactured from silicon carbide, fumed (amorphous pyrogenic) silica, silica or glass fibre filaments and calcium sulfate.

As it is lightweight, flexible and hardworking, PROMAGUARD® is ideal insulation and fire protection for a number of different applications on marine vessels of all types.

PROMAGUARD® can be configured to insulate steel decks and steel bulkhead structures, aluminium decks and aluminium bulkhead structures, sandwich or monolithic GRP decks and sandwich or monolithic GRP bulkhead structures. ☐

DISCLAIMER

The Promat International Asia Pacific Network spans the region with innovative proactive fire protection products, systems and solutions: Australia, China, Hong Kong, India, Malaysia and Singapore, with distributors in Brunei, Indonesia, Japan, New Zealand, Philippines, South Korea, Taiwan, Thailand and Vietnam.

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