MAGALDI NEWS

Issue 17 International 1/2014

DEPENDABLE PERFORMANCES

C O N T

MAC® EXPERIENCE AROUND THE WORLD

FOCUS ON INNOVATION

INDUSTRIAL DIVISION

E N T S

CUSTOMER SATISFACTION

This year is the 85th anniversary of the Magaldi Group establishment; today, as then, dependability continues to be the most leading motive of our innovative products, but it is not the only feature.
Our 1000+ worldwide references include the transportation of heterogeneous materials of any nature and temperature, enclosed in a tight casing to prevent any spillage of material into the environment and thus responding to the most stringent environmental regulations.
Our Superbelt® conveyors do not require large electrical power since they run smoothly as we removed by design any friction: the Superbelt® steel belt moves on rollers supported by bearings located outside the conveyor.
Furthermore, compared to traditional chain conveyors, our belts do not suffer from wear and tear, guarantee a longer service life - often more than 10 years - and require a simple scheduled maintenance. Thanks to our conveyors design, based on a multi-link concept, even if the double-wire mesh belt is severely damaged, the conveyor continues to run waiting for the next scheduled plant outage, while a failure on a traditional chain conveyor leads to the complete shutdown of the production line.
Over the years, we customized our systems in order to satisfy the most demanding needs of our clients: they are capable to handle capacities of over 1500 t/h and pieces weighing several tons.
During the transportation, we are able to cool down the materials through a controlled flow of cooling air or, if required, to keep the temperature high in order to save the valuable thermal energy, with large energy savings and productivity increase of the related plants.
Moreover, in our systems there is a separation from the handling area and the external ambient: such solution offers important environmental protection benefit.
I am also pleased to inform you that a very promising technology is under advanced development in Magaldi: STEM® (Solar Thermal Electrical Magaldi) is able to transform the solar energy into electricity, day and night.
Based on our strong experience, we are always glad to offer our Clients reliable solutions tailored for their needs.

Mario Magaldi
President & CEO
Magaldi Group
mario.magaldi@magaldi.com

South Korea

With MAR® saving money, auxiliary energy, preserving natural resources, land and environment

by **Ivano Pennella,** *Area Manager* ivano.pennella@magaldi.com
by **Simone Savastano,** *Area Manager* simone.savastano@magaldi.com

2012 has been a troublesome year for the South Korean power sector. A lack of investment in generation capacity and safety-related nuclear shutdowns left South Korea facing warnings of severe power shortages: the need to develop the country's energy infrastructure became a hot-button issue.

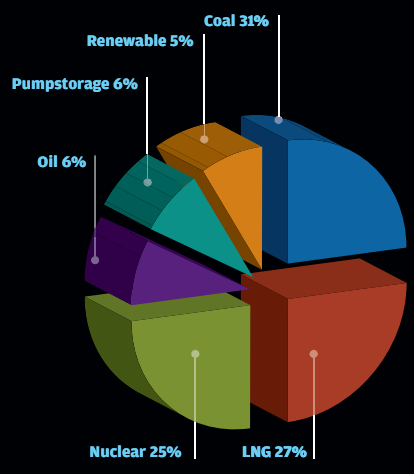
Renewable energy is the front runner, but old and dependable thermal power plants are still a viable alternative. The government's recent plan includes the construction by 2021 of coal fired power plants with a further capacity of 10000 MW with investment from both the private and public sectors.

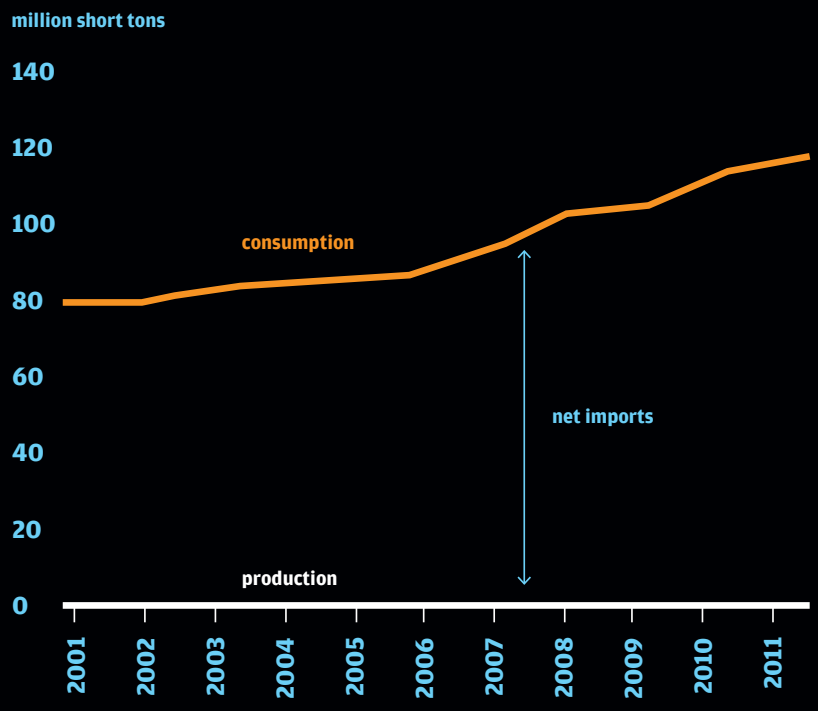
South Korea is the third largest importer of coal in the world, behind Japan and China. Australia and Indonesia account for the majority of South Korea's coal imports. Coal consumption in South Korea increased by just under 50% between 2005 and 2011, driven primarily by growing demand from the electric power sector: the electric power sector accounts for more than half of all coal consumption.

Low environmental impact, high efficiency and utmost safety for operators will be the key requirements of these new plants, thus the country situation looks extremely positive for the application of Magaldi technologies.

Not that the Magaldi name is new

South Korea total primary energy consumption by fuel type.





South Korea's coal production and consumption, 2001-2011.

MAR® system - Reception bin arrangement.

to the South Korean power sector. Currently 25000 MW of electricity generation in the country is based on coal or 31% of the total 82000 MW installed. Since 2004 all new PC fired boilers installed in the country have been equipped with dry bottom ash technologies. Magaldi Power's reference book in South Korea shows 16 references: 12 MAC® systems (including 4 for the 1000 MW boilers in Danjing and Shinboryong), 2 FLUIMAC® systems and 2 MAR® systems. Only one dry bottom ash handling system, made by an European competitor, has been installed, but this experience has not been repeated.

The latter are the latest additions: on June 13th 2013 BHI awarded to Magaldi Power S.p.A. the contract for the supply of two (2) MAC® + MAR® systems in Bukpyeong power plant.

More than two years of thorough negotiations and exchange of technical details were necessary in order to reach this result, involving Magaldi, the boiler supplier Bumwoo Heavy Industries (BHI), the engineering consultant Kepco E&C and all the bidders of the project.

Since inception, both STX EP and EWP held a clear vision: simply to make Bukpyeong TPP the most environmental friendly power plant project in Korea.

When it came to the bottom ash system, the MAC® solution was a straightforward choice thanks to its well-known advantages.

The Bukpyeong TPP will also sell the fly ash as additive to cement to local cement factories. A perfect fit in favor of the application of the MAR® technology, one of the newest technologies developed by Magaldi: that recirculating bottom ash in the boiler trough the coal mill transforms dry bottom ash in fly ash, simplifying and reducing the cost of the whole ash handling system.

Due to its design and technical characteristics the MAR® system is very versatile: the recirculation of the dry bottom ash in the boiler, through the coal mills, can be done in continuous or batch, according to End User's needs, as well as the dry bottom ash can be recycled in only one coal mill or in all coal mills at same time.

It has been tested, on an existing plant, that the installation of the MAR® System will slightly increase the wear of coal mills up to 2%, provided that, regular maintenance activities will be carried out. The slight wear increase of coal mills is well compensated by the elimination of all the costs associated with the installation, operation and maintenance of the ash pond itself and the related bottom ash transport system from the storage silo to the pond. Nevertheless, with the installation of MAR® system, all the environmental problems related to the bottom ash ponds, such as possible pollution of land and water, will be eliminated.

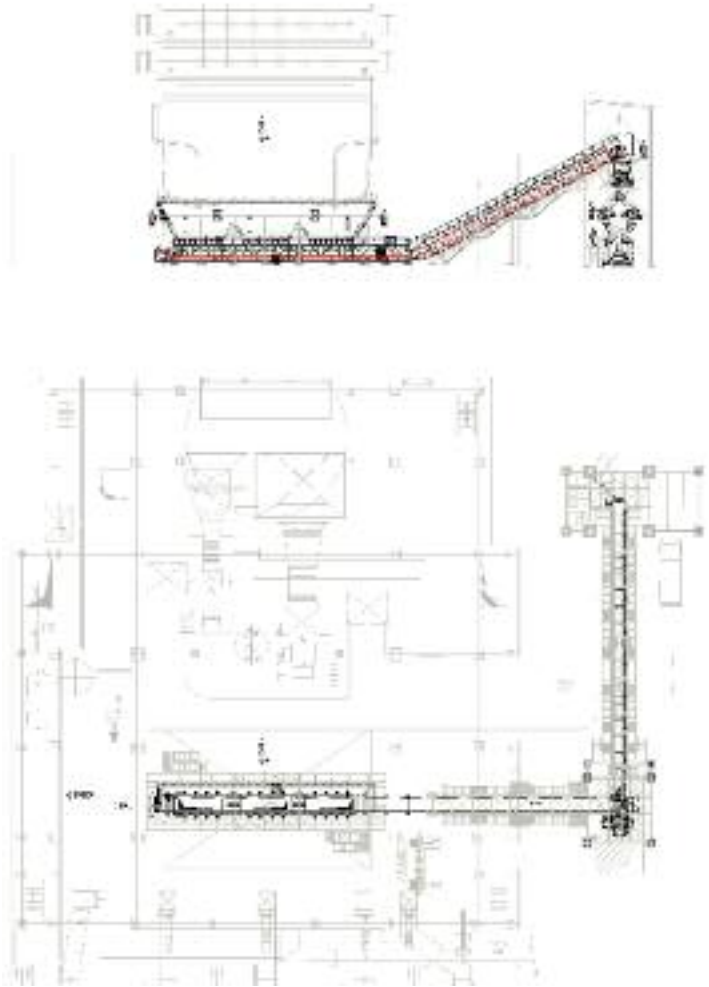
Since years, in Korea as well as in Japan, the dry bottom ash is pulverized using dedicated rod mills, up to a fineness comparable with the fly ash according to the strin-

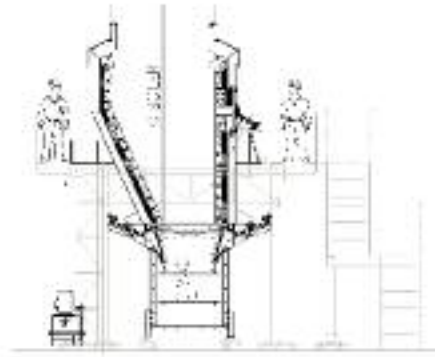
gent characteristics of cement industry, and mixed with fly ash for further use in the cement industry. Compared with this technical solution, the MAR® system is more convenient because, by avoiding the installation and use of dedicated rod mills, drastically reduces the energy consumption necessary for their operations. Moreover, the characteristics of milled bottom ash mixed with fly ash are similar to fly ash itself but are not the same.

And the "icing on the cake": the re-circulated bottom ash, that has been postcombusted in the MAC® extractor, now has a negligible UBC content. With MAR® system the quality of the produced fly ash increases, due to the dilution effect of the bottom ash into the fly ash: the fly ash then has a better value to cement factories. All fly ash and recycled bottom ash become a valuable product for the cement and concrete industry. In Bukpyeong power plant, bottom ash will no longer be considered a coal combustion waste but a useful by-product.

The project foresees the delivery of equipment for both units by the end of 2014 with the Commercial Operations Date (COD) expected for the beginning of 2016.

Magaldi Power S.p.A.
official agent in South Korea:
Total Tech Corp
Mr. Y.C. Shin - President
Seoul
e-mail: ttech@chol.com

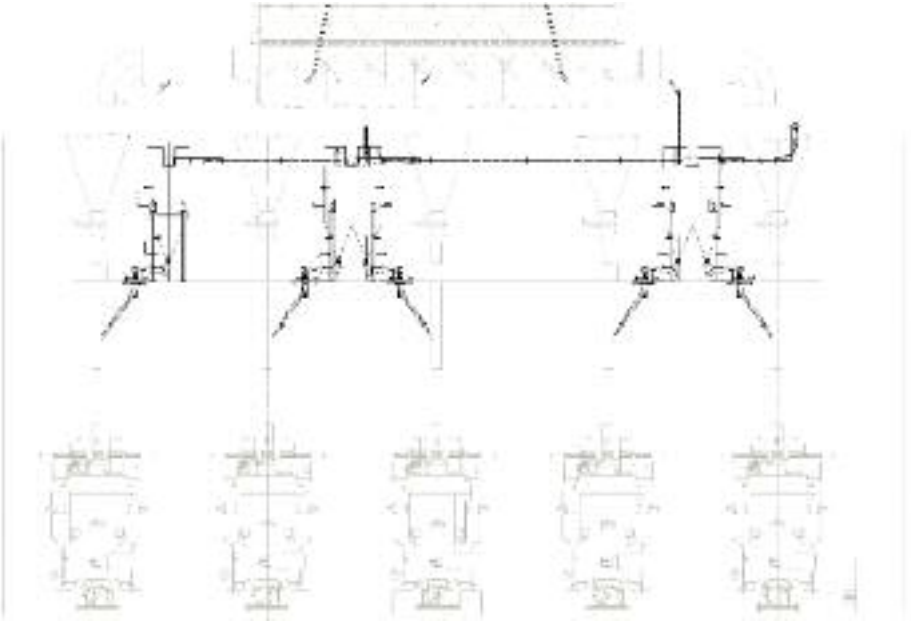




Bukpyeong MAC® system layout.

With its 1190 MW (595 MW x 2 Ultra Super Critical units) Bukpyeong Thermal Power Plant, located in Bukpyeong National Industrial Complex, Donghae City, Gangwon Province, will be Korea's first privately funded investment project. The Plant Owner has entered a joint venture between STX Electric Power (51%) and Korea East-West Power (49%). STX EP will be responsible for the construction and operation of the power plants, while EWP will be in charge of management, handling and maintenance.

The MAR® system is an improvement of the MAC® (Magaldi Ash Cooler) system for dry extraction, cooling and handling of bottom ash from solid fuel fired boilers. It is a process to recycle "dry" bottom and economizers ash in the combustion chamber in order to turn them into fly ash.



Bukpyeong MAR® system layout.

Setting new boundaries at the Shin-Boryeong Power Plant

The biggest Doosan boilers will be equipped with MAC® systems

December 20th, 2012 was an important day for the South Korean power sector: the groundbreaking ceremony for the Units #1 and #2 of Shin-Boryeong power plant was held in Boryeong-shi, Chungchengnam-do. The two ultra-super critical 1000 MW class units will be included in one of the largest coal-fired power plants in Korea and upon their completion, expected for June 2016 and June 2017 respectively, they are expected to heal the energy shortages affecting South Korea in these latest years.The importance of these units was mirrored in the choice by owner KOMIPO of state-of-the-art ancillary equipments and the bottom ash handling systems. Although two units of the nearby Boryeong power plant were equipped with dry bottom ash systems supplied by others, when the time came to choose the dry bottom ash system for the new units the obvious choice was the Magaldi Power MAC® system - the mostly recognised and referenced dry bottom ash extraction system of the world. These new MAC® systems will match the record for the size of the boilers served by our dry bottom ash handling system - being the two systems to be installed under the 1000 MW units #9 and #10 of Dangjin Thermal Power Plant, owned by EWP, contracted in 2011 and currently under construction.

South Korea

Yeosu #1: after Yeosu #2 Project, FLUIMAC® technology reconfirmed for the new 340 MW FBC Boiler

by **Ivano Pennella,** *Area Manager* ivano.pennella@magaldi.com
by **Lorenzo Lepore,** *Process Engineer* lorenzo.lepore@magaldi.com

Fluidized Bed combustion, introduced in the early '80s, allows boiler and power plant operators greater flexibility in burning a wide range of coal and other fuels. This technology helps to overcome problems related to the use of low quality fuels that are difficult to ignite, without compromising efficiency and with reduced pollution.

So popular has this technology continued to be that today's markets require FBC boilers of constantly increasing size, up to 600 MWe and more. To keep pace with these increases requires not only advanced boiler technology but also auxiliary system improvements.

One of the critical auxiliary systems of a FBC Boiler is a bed ash extraction system capable of removing and cooling hot and abrasive materials of varying size. Difficult working conditions for these systems lead to continuous wear and frequent maintenance, involving high costs, up to a point that an unexpected failure of the bed ash extraction system could cause a boiler forced shut down.

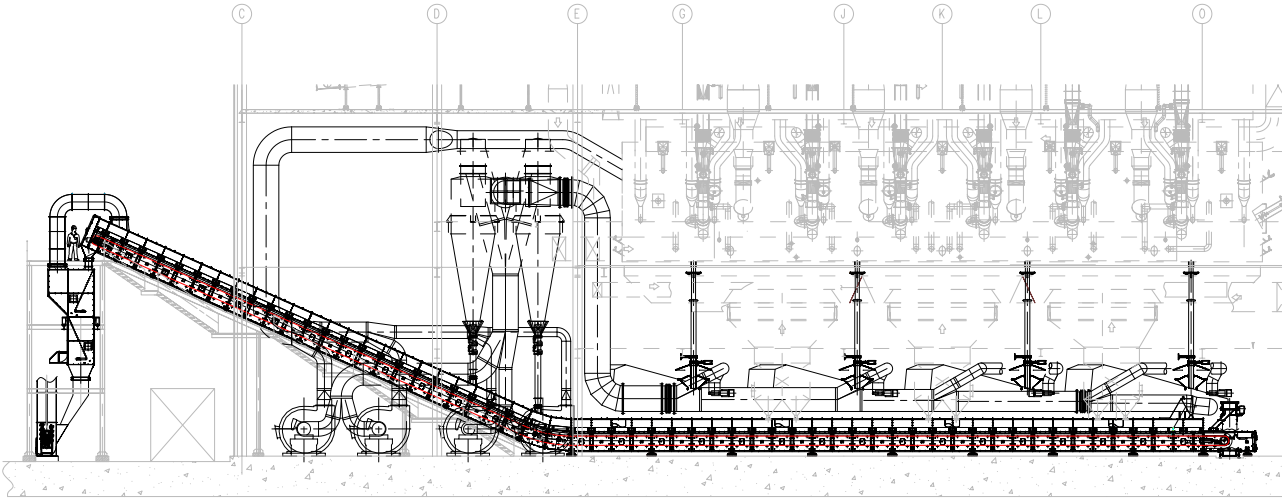
Such problems are overcome by the Magaldi FLUIMAC® technology. By applying the same field-proven technology used for bottom ash extraction from PC boilers, Magaldi developed the FLUIMAC® System for FBC boilers. The FLUIMAC® extracts and cools the bed ash overcoming the main drawbacks of conventional systems such as mechanical wear, maintenance cost and loss of ash heat content.

The Magaldi FLUIMAC® is directly connected to the FBC Boiler drain pipes. The ash is extracted by the Magaldi Superbelt® through a special distributing device. The ash rate is regulated by means of belt speed variation (provided by an inverter drive) assuring an accurate control of boiler bed material height. The Superbelt® runs inside the casing of the FLUIMAC® Extractor, which is completely sealed and where a negative pressure is maintained. The cooling medium is air: no water is required. A controlled amount of cooling air is drawn from the ambient into the FLUIMAC® Extractor through properly sized inlet valves located on the casing. Cooling air flows in countercurrent to the ash being conveyed and takes heat from the hot ash. Hot air out of the FLUIMAC® System can be delivered to the secondary air duct by a dedicated fan, allowing for consequent heat recovery to the boiler.

The FLUIMAC® System has a brilliant history in South Korea: on June 2011 the FLUIMAC® System for the 340 MW FBC boiler installed at Yeosu #2 Thermal Power Plant successfully started operations. After 2 years of trouble-free continuous operation, the FLUIMAC® System has confirmed the expected targets:

- Safety and dependable operations: no boiler stoppage due to the FLUIMAC® System (100% of dependability)
- Minimum wear: all the conveyors were found to be in perfect condition during the inspection in September 2012; Magaldi Superbelt® confirms its special design and unique advantages
- No water consumption
- Heat recovery of bed ash heat to the boiler
- Efficient ash cooling.

The outstanding results shown during operation of the FLUIMAC® system of Unit #2 helped KOSEP and Doosan Heavy Industries to decide to install a FLUIMAC® System in Yeosu TPP serving the new 340 MW



Yeosu #1 FLUIMAC® system layout.

The two main characteristics of the FLUIMAC® System are the absence of wear, since there is no relative motion between the Superbelt® and the ash transported on it, and the recovery to the boiler of the latent heat contained in the ash bed, leading to increased boiler efficiency.

FBC boiler to be installed at Unit #1. The contract for this new bed ash extraction system was signed on 06 August 2013.

This latest addition to the FLUIMAC® family is designed for extracting and cooling 18 t/h of ash during continuous operation and up to 36 t/h of ash in emergency conditions. The boiler has 4 drain pipes for bed ash extraction and one FLUIMAC® conveyor is installed for each drain pipe.

FLUIMAC® conveyors discharge the ash into a secondary conveyor: the Magaldi Ecobelt®, which, thanks to the Magaldi Superbelt® technology and the patented method of connecting the pans to the mesh belt is able to convey extremely hot, dusty, sharp and abrasive materials, even if containing fines or lumps, over long distances and with steep inclinations avoiding all the issues related to high temperatures and tear.

The Ecobelt® is able to overcome the frequent problems encountered by conventional conveyors, such as drag chain conveyors, which due to high temperatures, heavy loads, abrasiveness, corrosiveness or sharp edges of bulk materials suffer from several operational problem.

Drag chain conveyor cannot guarantee continuous operation since their mechanical and thermal

Table below indicates the operating conditions and the parameters measured at Yeosu #2 installation:

FLUIMAC® Extractor in operation	1
Bed Ash Rate	2.4 t/h
Cooling Air Rate	4.5 t/h
Air/Ash Ratio	1.85
FLUIMAC® Extractor Bed Ash Inlet Temperature	750 °C
FLUIMAC® Extractor Bed Ash Outlet Temperature	260 °C
FLUIMAC® System Final Bed Ash Temperature[1]	70 °C
FLUIMAC® System Cooling Air Inlet Temperature	28 °C
FLUIMAC® System Cooling Air Outlet Temperature	258 °C

1. This value refers to the ash temperature at FLUIMAC® system discharge after Secondary Conveyor and Contact Cooler device.

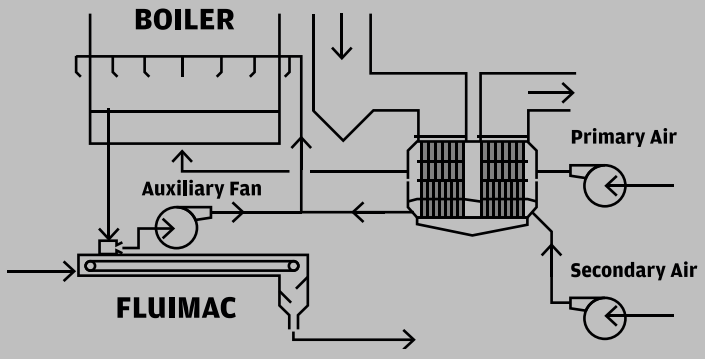
For more information on the first FLUIMAC® system installed under boiler #2 of Yeosu thermal power plant, please see Magaldi News Issue 16, pag. 8.

The FLUIMAC® system at Yeosu #2 Power Plant.

HEAT RECOVERY & INCREASE OF EFFICIENCY

The FLUIMAC® system, unlike traditional systems, gives the possibility to recover ash heat: the air heated by the ash is delivered back to the boiler.
The potential heat to be recovered from the ash is high. For example considering:
- Bed ash rate = 10 t/h
- Bed ash specific heat = 1.0 kJ/kg °C
- Bed ash initial temperature = 900 °C
- Bed ash final temperature = 100 °C

The potential heat from ash is approx 2.2 MWt which, assuming plant efficiency of 0.40, equals approx. 880 kWe.
Heat is recovered by introducing the heated air from the FLUIMAC® system to the boiler's secondary air duct, downstream the flue gas heat exchanger.



resistance is not sufficient to withstand the high wear caused by the relative motion between the conveyor parts and the handled abrasive materials. If an unexpected failure occurs to just one component (link, sprocket, etc.), drag chain conveyors suddenly stop the production line for the whole period necessary to repair the breakdown.
Wear, power demand for conveying, noise and maintenance are negligible for the Magaldi Ecobelt®, since material is slowly conveyed with no relative motion against steel parts. In most cases the Magaldi Superbelt® operational life exceeds 10 years.
At the secondary conveyor discharge the ash can be further cooled inside a special cooling device, called Contact Cooler: an ash/air heat exchanger whose purpose is to further reduce the ash temperature.
Ambient air only cools the ash. Dedicated fans draft the ambient air that flows inside the conveyors and delivers it to the boiler secondary air duct thus performing heat recovery.

Russia

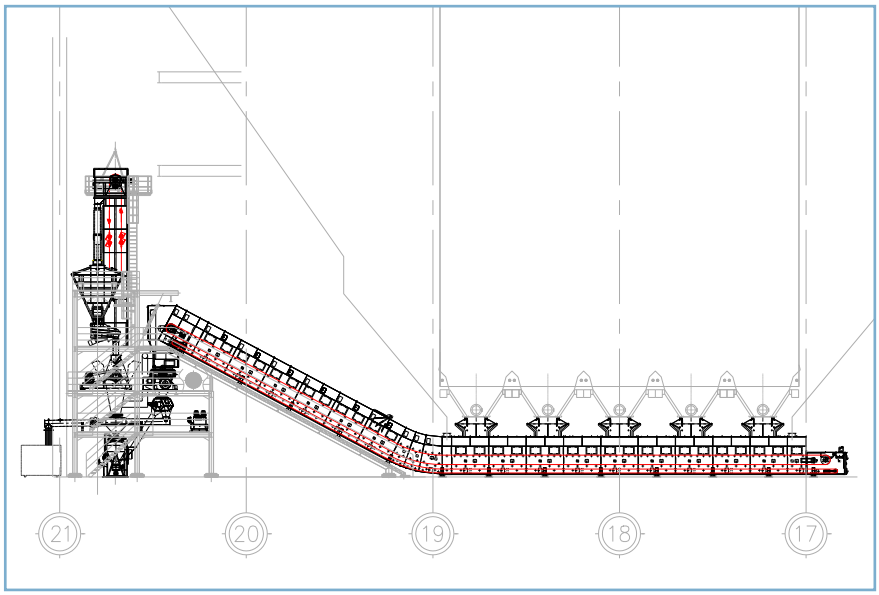
Magaldi Power S.p.A. environmentally friendly solutions for Russian coal-based power generation: the largest dry ash handling system in Siberia

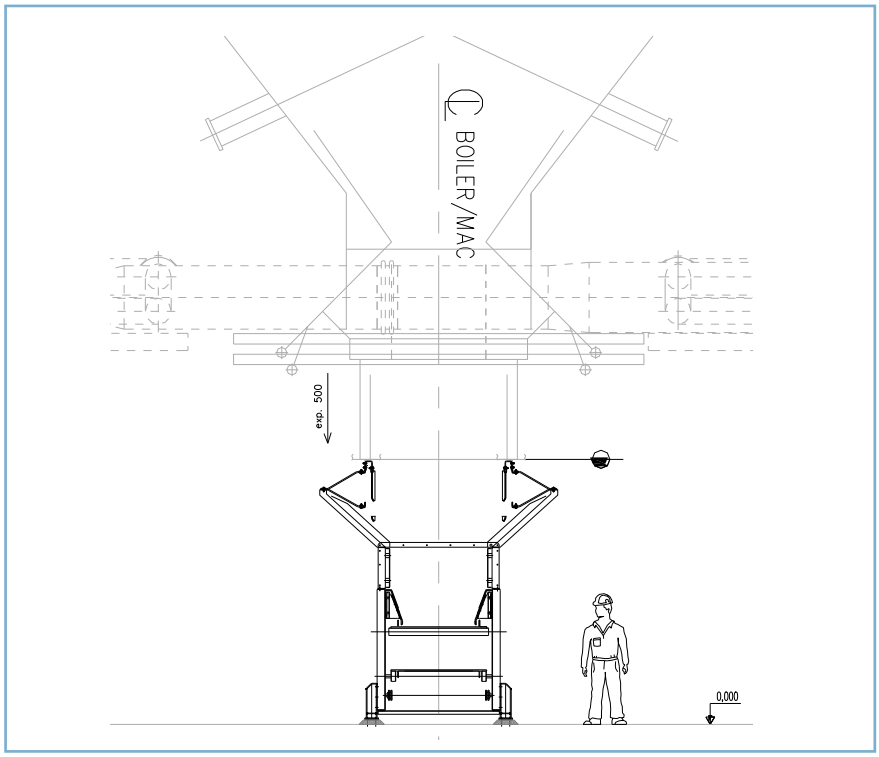
by **Daniele Coppola,** *Area Manager Magaldi Power S.p.A.* daniele.coppola@magaldi.com
by **Anton Kuzmin,** *Director for technical development and new technologies JSC Cotes* anton.kuzmin@cotes-group.com

In March 2013 Magaldi Power S.p.A. secured an order for the delivery of its first Magaldi Ash Cooler (MAC®) system in the Russian Federation for the third power unit at the E.ON Russia Berezovskaya GRES.

Magaldi Power S.p.A. will deliver its first MAC® system for dry bottom ash handling in the Russian Federation in the Krasnoyarsk region. The contract was awarded in March 2013. Magaldi Power S.p.A. has been selected by JSC "E.ON Russia" for the design and supply of the largest dry bottom ash handling system in the Russian Federation for the third 800 MW power unit of Berezovskaya GRES. This important achievement was reached thanks to the continuous support from JSC "COTES-Sibir", a member of COTES Group and a strategic partner of Magaldi Power S.p.A. in the Russian power sector. Berezovskaya GRES is one of the largest coal-fired power plants in Siberia. Constructed in the 70's, the original Soviet project envisaged construction of eight power units of 800 MW capacity each. However, only two boilers were ever built and went into operation in the late 80's. The third power unit was manufactured and delivered to site in early the 90's but never put into operation.

In 2006 Berezovskaya GRES was incorporated in JSC "E.ON Russia". The company's Russian generation fleet is the third-biggest in E.ON's portfolio after Germany and the UK and the installation of the third unit in Berezovskaya GRES represents one of the major new-build projects currently underway in Russia in terms of unit capacity. When Unit 3 of the Berezovskaya GRES comes online it will improve energy reliability for the Krasnoyarsk region and Siberia. The new unit is scheduled to be completed by 2015 with the capacity of Berezovskaya GRES reaching 2400 MW.
The general contractor of the project will manage construction of the project on site. An upgraded P-67 steam boiler will be supplied by EM-Alliance and steam turbo set K-800-240-5 of 800 MW capacity will be manufactured by Power Machines.
Indicative of the modernization that is taking place in the E.ON Russia generating fleet, the new unit will be equipped with a dry bottom ash handling system. Traditionally, all Russian power plants have used wet ash handling systems, with the wet bottom ash waste being conveyed to an ash dump for storage creating problems of overfilled ash dumps and the potential for environment damage. These concerns led JSC "E.ON Russia" to employ state-of-art technology for dry ash handling on the new unit representing a significant milestone in Russian power generation.
Magaldi Power S.p.A. will design, manufacture and commission the new bottom ash handling system from under the boiler hoppers to the crushing stage. The MAC® system will incorporate the Superbelt® technology based on a damage-tolerant air-cooled steel belt. Bottom ash will be conveyed by a bucket elevator and transferred to a milling station where two hammer mills will reduce the grain sized ash down to a particle size suitable for pneumatic transportation. The bottom ash will then





Berezovskaya GRES MAC® system layout.

be mixed with dry fly ash from the electrostatic precipitators and transported to its final destination.
The first order for the supply of the first dry bottom ash removal system in the Russian Federation represents another sign of confidence in Magaldi Power S.p.A.'s competence and immense experience gained from more than 160 installations wordwide.
It is in places like Siberia, where the extreme winter weather conditions puts the production assets under a great pressure, that the introduction of the Magaldi dry bottom ash technologies will provide advantages to the higher extent. Thanks to the water-free MAC® bottom ash system, Berezovskaya GRES power plant will be allowed to provide electricity and heat to its customers without having to face any risk of ice formation in the bottom ash handling system.

Reference:

E.ON Russia, JSC (http://www.eon-russia.ru/) is involved in generation and sales of electric and thermal power. It was founded in 2005 with its five power plants, and in 2007, became part of the international E.ON. Currently, the total installed capacity of E.ON Russia is 10345 MW due to the implementation of a greenfield construction investment and rehabilitation program.

COTES-Sibir is an official partner of Magaldi Power S.p.A. in Russia and CIS, it belongs to the **COTES Group (http://www.cotes-group.com/)**, which has been in the power industry market since 1992. COTES Group specializes in design, engineering and technological work, such as examination, commissioning and testing of equipment for large-scale power generating facilities and industrial enterprises in Russia and abroad.

Words:

GRES: The term GRES (ГРЭС in Russian language) refers to a condenser type electricity-only thermal power station introduced in the Soviet Union and which still exists in the Russian Federation and other former Soviet republics. The Russian abbreviation ГРЭС stands for Государственная районная электростанция, or "State district power plant". Over time the abbreviation has lost its literal meaning, and the term now refers to a high-power (thousands of megawatt) thermal power station of condenser type.

Interview with Mr. Polovinchikov:

Q: What were the main reasons for selecting a dry bottom ash handling system for your new power unit at the Berezovskaya GRES?
Mr. Polovinchikov: Today more and more attention is devoted to issues of environmentally friendly coal-based generation in Russia. At the same time, utilization of bottom ash waste from PC-fired thermal power plants is one of the key challenges. Conventional ash removal methods at the Russian power plants use wet ash handling systems, which results in a great number of environmental and operational problems. To address these issues, E.ON Russia, being the company aimed at modern energy efficient technologies, uses Magaldi dry ash handling system.

Q: What are the main features/advantages offered by the MAC® system that are considered of most interest for your power unit?
Mr. Polovinchikov: Its main advantage is reliability. The MAC® system calls for minimal operation and repairs with lower auxiliary requirements. Moreover, bottom ash heat will not be lost with water as in a conventional system, which improves boiler efficiency and saves fuel.

Q: Would you recommend the MAC® system to other plants' Director or Utilities Managers?
Mr. Polovinchikov: I think that today the application of cutting- edge energy efficient and environmentally friendly technologies, such as the MAC®, are critical for Russia and such technologies should be applied for the construction of new generation facilities in Russia and for retrofit of existing installations.

Grigory Polovinchikov (Head of New Generation Department JSC "E.ON Russia") in his office in Moscow.

India

A cauldron of opportunities

by **Debasish Chakraberty**, *Magaldi Power India PVT. Ltd. Country Manager* debasish.chakraberty@magaldi.com

After nearly a decade of rapid growth marked by reform and investment, India's power sector has reached a new period of skepticism. Concerns about fuel availability, the financial health of state-owned distribution companies and land and environmental issues have bubbled back up to the surface. Meanwhile, rising costs could threaten the viability of new projects.

In spite of the aforementioned odds, the Indian power sector still holds much promise and despite a gloomy short-term picture, the medium to long-term outlook appears to be much more optimistic.

India's energy portfolio is dominated by fossil fuels (coal, gas and oil), which have long had availability problems. Rapid economic growth has only exacerbated this. Supply continues to struggle to keep pace with demand because of productivity problems, logistics, a lack of accessible reserves, environmental concerns and genuine will to act in the corridors of power!

Regulatory controls over prices, production and allocation of fuel are also leaving a mark on the energy sector, distorting market mechanisms and dissuading significant progress. Almost half of India's energy consumption is subsidized-including power, transportation and process heat requirements.

However, as fuel shortfalls and subsidies become untenable, policy makers will have to launch reforms. These include market-driven pricing, fuel supplies based on market dynamics rather than government mandate (although broad guidelines would likely continue to exist), accelerating coal and gas development, and separating the roles of producer, regulator, and policy maker to bring better governance.

These reforms, already underway and if properly executed, will have a significant positive impact on economics, business models and technologies.

The demand for electrical energy should continue to grow in tune with the projected growth of economy and a number of power projects are planned in the 12th Five Year Plan both at pit head and coastal locations requiring a very large area of land for main plant, ash disposal and other facilities.

Land is precious in India from the point of view of availability and the costs involved, and an urgent need has been felt to rationalise practically the land requirement for the thermal plants.

Government Nominated Expert Committees have studied the power plant layout practices being followed in India and abroad and deliberated on the land requirement for various facilities for the pit head and coastal power plants in order to optimize the land usage.

In view the stipulations of The Ministry Of Environment & Forests (MOE&F), Government of India, there is an urgent need to further increase the ash utilization and reduce ash dyke area so as to conserve land.

The power project developers need to explore the ways for having a further possible reduction in land requirement especially for ash dyke and colony to reduce the overall requirement for the power plant.

Bottom ashes processed by the Magaldi Bottom Ash Cooling and Handling system (MAC®) are completely dry and drastically reduces the size of ash ponds; the low LOI of the bottom ashes from the Magaldi system ensures its eligibility for cement manufacture.

When both bottom and fly ashes are used in cement manufacture, ash pond requirement is virtually eliminated.

Dry bottom ash from the Magaldi MAC® system also finds uses in manufacture of bricks, road surfacing, land fills and a host of other applications.

Shortage of water and environmental concerns associated with ash generation in thermal plants have resulted in adoption of various measures for reducing consumptive water requirement for ash disposal.

Disposal of fly ash in the dry form and 100% utilisation within a fixed period is a statutory requirement today.

Various practices for savings in water for bottom ash disposal are

MAC® system in operation at OPG Power Plant.

also being attempted and enforced. This still remains an extreme concern!

The dependable and well proven MAC® system completely eliminates usage of water from the bottom ash handling process leading to "Zero Discharge and the most Environmentally Friendly system".

Magaldi India Ltd have been building up steadily on their large reference base for dry bottom ash MAC® systems in India.

Orders from the following customers have been obtained till now this year:

- 2 x150 MW Units for OPGS Gujrat Pvt Ltd, Bhadreswar, Gujrat; Boiler Manufacturer BHEL
- 1 x 160 MW Unit for OPG Power Generation Pvt Ltd, Guminipoondy, Tamilnadu; Boiler Manufacturer IJT.

The following MAC® systems have been commissioned in this financial year:

- 80 MW Unit of Sarda Metals & Alloys, Vizianagaram, AP; Boiler Manufacturer Enmass
- 300 MW Unit 1 of GMR Energy Ltd, Warora, Maharashtra; Boiler Manufacturer, SEC
- 90 MW Unit 3 of OPG Power Generation Pvt Ltd, Guminipoondy Tamilnadu; Boiler Manufacture.

With the above three a total of 11 nos MAC® systems are in operation in India; DPL Unit 7 of Durgapur started first in December 2007.

Installation of the following MAC® systems are underway:

- 300 MW Unit 2 of GMR Energy Ltd, Warora, Maharashtra; Boiler Manufacturer: SEC
- 250 MW Unit 8 of Durgapur Projects Ltd, Durgapur, India; Boiler Manufacturer: BHEL; SUPERMAC®

system
- 2 x 150 MW Units no 3 & 4 of Aditya Aluminium (Hindalco Industries), Lapanga, Orissa
- 4 x 360 MW Units of RKM Power Gen.

The MAC® system has 27 references in India. All of the MAC® systems are installed/would be installed below new boilers in India.

The next aim are retrofits below power stations already under operations. Serious investigations for such retrofits are already under progress and results should be forthcoming in the short run.

The mainstay of the Magaldi Plants/Systems is the Magaldi Superbelt®; a metal conveyor driven without any chains or sprockets. Traditional metal conveyors all are driven through chains and sprockets which are the bane of metal conveyors. The Magaldi Superbelt® on the contrary operate exactly like a rubber conveyor belt by friction and scores on several accounts over conventional metal conveyors.

The design of the Magaldi Superbelt® is used in a slew of Magaldi Industrial Plants/Systems including:
- The MAC® system for dry bottom ash handling
- The Magaldi Ecobelt®: an ideal conveyor for handling hot materials, aggressive chemicals, sharp products while providing safe and completely enclosed operations
- Use in several heavy duty foundry applications:
  - Casting cooling
  - Casting sorting
  - De-Gating
  - Casting & Sprue transportation
  - Loading/Unloading shotblasting &
  - Mould transportation.

The first Magaldi Superbelt® installation in India was in 2004 at Rico Auto for casting cooling and sprue removal; three additional casting cooling conveyors were procured by Rico Auto in 2006. These installations at the premises of one of the leading foundries of India set the trend for other equally important clients. Since then nine more Superbelt® adorn the plants of:
- Turbo Industries, Ludhiana, Punja
- Amtek India limited, Bhiwadi, Rajasthan
- Texmo Precision Casting, Coimbatore
- Munjal Kiriu Industries, Manesar, Haryana.

Even in this period of slowdown in the automotive & allied industries in India, Magaldi India is in the process of negotiating with some more prestigious customers and we expect to score very soon. This portrays the confidence customers have on the pioneering and path breaking Magaldi Superbelt® in India!

Magaldi India has also started manufacturing at their works in Vadodara since September 2012 and this has given a new dimension to the Indian operations. Further indigenization of manufacture is on the cards; to be coupled with augmentation of the manufacturing facilities at possibly another location.

Percolation of the news of long and sustained operation of the MAC® systems in India have evoked a lot of interest and several of our installations continue to receive footfalls from possible clients from India as well as from outside the country, including possible clients from South Africa.

New innovative processes and technologies are being developed by the select and highly fecund R&D department located at our Head Office in Salerno, Italy to thwart competition and continuously give Magaldi Group the edge.

Marketing/Commercial activities of our latest technologies are going on steadily; fresh grounds are being targeted/investigated both for the MAC® system and Superbelt®. Some new tie ups are also on the cards.

Overall things sound very promising indeed!

MAC® system typical configuration.

USA

The MAC® Magaldi Ash Cooler system at the Dry Fork Generating Station has successfully been in operation during past two years

by **Daniele Coppola,** *Area Manager*
daniele.coppola@magaldi.com

The second MAC® system installed in the United States commenced operations at the Dry Fork Power Plant in 2011.
The start-up of the new dry bottom ash handling system has been the culmination of what has been a joint project with Magaldi Power's Licensee Allen-Sherman-Hoff during the past years.
In 2008 The Babcock & Wilcox Company awarded Allen-Sherman-Hoff, partner of Magaldi Power S.p.A. in USA, a contract to supply a dry bottom ash handling system for its new sub-critical pulverized coal boiler at the Dry Fork Generating Station, owned by Basin Electric Power Cooperative. The North Dakota-based power cooperative started construction in October 2007 and the dedication ceremony of the plant took place in August 2011.
Located seven miles north of the city of Gillette, WY., the new 385-megawatt pulverized coal-based plant is being constructed to meet the growing electricity demand of the surrounding states, and incorporates the most advanced environmental control technology.
The new boiler burns Powder River

Basin (PRB) coal supplied from the nearby Dry Fork Mine. PRB coal is a high-slagging fuel and produces ash with high calcium content compounds, when compared to bituminous coal ash. Conventional wet ash handling systems can be a concern for power plants where high calcium content ash is produced. Ash created by the combustion of PRB coal, has a tendency to harden with the presence of water and build up in the handling systems. By completely eliminating the use of water and associated risk of ash conglomerations, the MAC® system dry technology is the recommended solution for high calcium ash applications, enabling the continuous and safe transportation of bottom ash to a collecting silo.

The steam generator is equipped with the MAC® designed by Magaldi Power S.p.A. and supplied by Allen-Sherman-Hoff under Magaldi Power S.p.A. license. The coarse ash falling down and leaving the furnace through the refractory lined hopper is collected, air-cooled and transported by the Magaldi Superbelt® stainless steel conveyor. The refractory lined hopper has been equipped with hydraulically driven bottom doors, special valves which can isolate the ash hopper at the bottom of the boiler, transforming it into a temporary ash storage volume. After discharge from the Magaldi Superbelt®, the ash size is reduced in two single roll crushers, thus enabling pneumatic conveying transportation of the bottom ash up to a dedicated storage silo.

The Magaldi Power's MAC® technology, which is designed to eliminate the use of water, as well as recover heat energy to the furnace resulting in lower fuel consumption, was considered the perfect choice for the bottom ash handling system at Dry Fork Generating Station. The new MAC®, in steady operations since 2011, offers a high-quality and environmentally-sound ash handling system in a water-constrained area. State-of-the-art dry ash handling systems from Magaldi offer greater equipment reliability and the broadest range of customized solutions to better serve ash removal operations.

The MAC® system properly addresses the demand of coal-fired power plants for sustainable practices in ash handling. Dry coal combustion by-products can directly contribute to the effort towards the request of the most environmentally-sound method of disposal. Ash re-use offers reduction of greenhouse gas emissions and conservation of natural resources. Safe beneficial use of dry ash should be viewed as a preferred alternative to ash ponds, avoiding the need for additional landfill space through sound technical and environmental management practices.

The Magaldi Group is also present in the North America market through its sister company Magaldi Industrie S.r.l., leading manufacturer of industrial systems and plants for bulk material handling at high temperatures and heavy conditions. Magaldi Industrie Srl is able to offer a comprehensive product portfolio and innovative solutions for customers active in different type of production processes for hot, abrasive and heavy material transportation. It is worthwhile mentioning some of the most recent projects awarded by the Magaldi Group in North America:

- Greede group for one of its foundry in New Castle (IN) is using the Magaldi Superbelt® PR type conveyor for casting sorting and degating
- Alamo Cement in San Antonio - Texas is using the Magaldi Superbelt® conveyor for hot clinker transportation for more then twenty years
- Showa Denko Carbon Inc in South Carolina is implementing more than 300 meters of Magaldi Superbelt® for very high temperature material handling
- Ivaco Rolling Mills in Canada is using two Magaldi Superbelt® conveyors for scrap handling and EAF furnace charging.

Those are only some examples of more than 40 conveyors actually working in different processes in USA customers.

PROJECT FACT

End User	Basin Electric Power Cooperative and the Wyoming Municipal Power Agency
Plant Operator	Basin Electric Power Cooperative
Architect/Engineer	Sargent & Lundy, LLC, Chicago
Output	385 MW
Boiler manufacturer	The Babcock & Wilcox Company
Coal	Sub-bituminous from the Powder River Basin's Dry Fork Mine in Wyoming
Ash rate	6 t/h
Ash rate max	8 t/h

MAC® system at Dry Fork Power Station - tail section view.

Development from MAC® to SUPERMAC® technology

by **Alberto Carrea**, *Senior R&D Consultant* alberto.carrea@gmail.com
by **Fulvio Bassetti**, *Technical Manager* fulvio.bassetti@magaldi.com
by **Daniele Ricci**, *Senior Process Engineer* daniele.ricci@magaldi.com

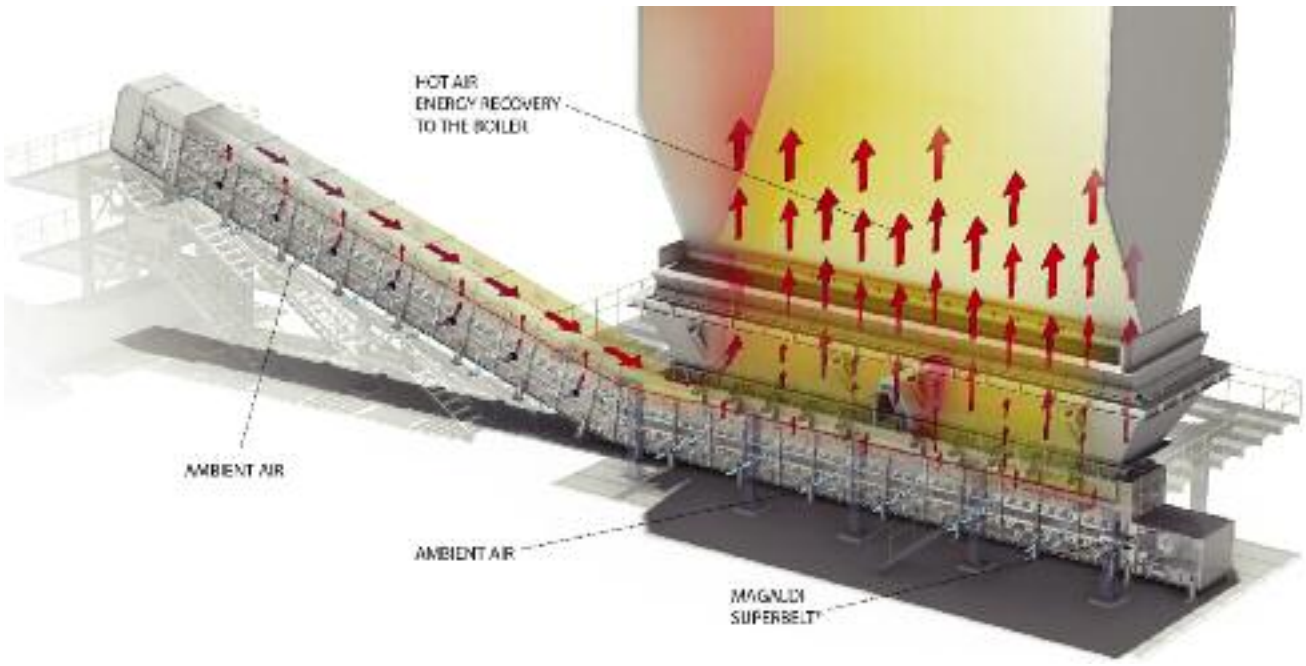
The continuous development of Magaldi technology in dry bottom ash extraction from PCF boilers has resulted in a significant reduction in the amount of air required to cool bottom ash with the twofold advantage to apply the MAC® system to large low-rank coal fired boilers and to further increase the boiler efficiency.

To prove this and in compliance with ASME PTC 4-2013, evaluations on boiler efficiency increases associated with the installation of the MAC® system were carried out.

As an alternative option to the conventional Wet Bottom Ash Systems (WBAS), the MAC® system is a technology for the dry extraction of bottom ash from pulverized coal-fired (PCF) boilers of any size and burning any type of coal. The MAC® dry bottom ash handling offers zero-water consumption and reduces the intrinsic heat losses associated with conventional WBAS. Developed by Magaldi in the early '80s, the MAC® system is the most referenced dry system on the market, with more than 160 units in operation, serving more than 60 GW of installed power, totaling approx. 1200 continuous years of trouble-free and safe operation.

All conveyors in the MAC® system are based on the damage-tolerant Superbelt® design, which offers unique features of high temperature and impact load resistance, high tensile strength, preventing any sudden system sudden failure or forced boiler shutdown, that can be associated with bottom ash handling systems.

Complete integration of the boiler with the MAC® dry technology optimizes the overall system performance and has proven to have a positive impact on increasing boiler efficiency, achieved through the use of air as the cooling medium of ash, rather than water. Cooling air enters the boiler through the bottom



SUPERMAC® system - cross flow cooling.

opening and, after cooling bottom ash, the now heated air sucks back into the furnace the energy, otherwise escaping in a WBAS, in the form of ash sensible heat, ash chemical energy and boiler radiation flux.
Assessment of the technical, economic and environmental performance of the MAC® dry bottom ash application is possible, through in depth evaluations of increased efficiency, associated with savings of coal, carbon dioxide emissions, auxiliary power consumption, in the framework of the ASME PTC 4-2013 code.
In a MAC® system, certain values of the cooling air to bottom ash ratio, in weight, are required, depending on the weight of the radiation flux on the overall energy escaping. Air is an excellent medium to reintroduce the escaped energy into the boiler, however there are two points to consider.
First, boiler manufacturers request limits of cooling air to 1.5÷2.5% of the total combustion air, to avoid undue disturbance in the burner-furnace fluodynamic.
Second, the cooling air is still combustion air and requires parallel reduction of air to the burners; the effect is a small decrease in the air to the Air Heater, resulting in a small increase of the flue gas temperature at the stack, thereby partially reducing the energy recovery.
Focusing on the first point, the practical effect is that, as the ash content in coal increases, the cooling air requirement increases and, at a certain level, it may exceed the limit imposed by the boiler manufacturer. Thus this requires a method to substantially reduce the cooling air to bottom ash ratio, in order to realize a more effective ash cooling process. The SUPERMAC® system was developed with this in mind. With the SUPERMAC® the necessary cooling air to bottom ash ratio can be reduced to approximately 50% of the previous values, needed by a conventional MAC® solution. In the SUPERMAC® a cross-flow (see figure above) between the ash on the belt and the air flowing through the ash layer is created, to obtain an intensive ash cooling thanks to an intimate contact between air and each ash particle being transported.
ASME PTC 4 Committee clarifies the Code guidelines for boiler efficiency calculation in case of Dry bottom ash systems.
Regarding the second point, the reduction of the cooling air requirement of the SUPERMAC® gives the additional advantage to get a steam generator efficiency improvement higher than before.

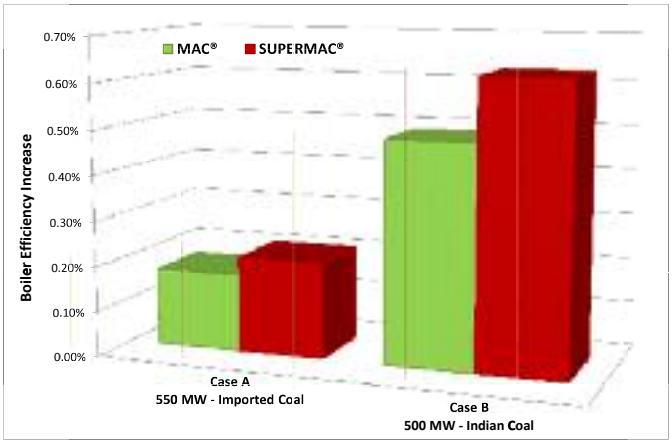
EVALUATION OF BOILER EFFICIENCY IN CASE OF MAC® SYSTEM

It is worth mentioning that some years ago Magaldi decided to conduct a rigorous assessment, within

the framework of the ASME PTC 4 code, to evaluate the dry bottom ash technology impact on the overall boiler efficiency, compared to a conventional WBAS.
At that time, the ASME PTC 4 described how to calculate the heat losses due to radiation through the furnace hopper throat and the sensible heat in the residues, discharged through the bottom ash system, providing a detailed procedure only for WBAS.
Due to the increasing interest in the innovative MAC® dry technology, the question arose on how the ASME procedures could be applied for determining heat losses and credits, when the boiler is equipped with a MAC® dry bottom ash removal system, that's to say when using a given amount of ambient air instead of the water for the bottom ash cooling.
To clarify such issues, an inquiry to ASME was submitted by Magaldi, detailing the dry bottom ash technology and its impact on the boiler efficiency, according to Magaldi's knowledge. After internal study, the ASME PTC 4 committee confirmed that even though only a wet bottom ash handling system is described in detail in the code, the concepts in PTC 4 are applicable also to steam generators equipped with dry bottom ash removal systems.
According to this PTC 4 code clarification, that fully complies with its interpretation given by Magaldi, the comparison among the bottom losses and credits in the two cases, WBAS and MAC® (or SUPERMAC®), must be done after a proper selection of the control volume and can be summarized in the following table.
In addition, ASME confirmed to take into account the effect of the small reduction of the air to the Air Heater. This is the key-point where the SUPERMAC® provides additional benefits, since the cooling air requirement have been minimized.
A further advantage affecting the boiler efficiency is given by the cooling air, entering the boiler throat at quite high temperatures, because of the heat recovered by the bottom ash cooling. This high temperature air creates a hot and oxidizing atmosphere in the lower part of the boiler (immediately above the boiler throat) and in the MAC® extractor, which produces a strong reduction of the UBC (i.e. unburned carbon) content. Such UBC content reduction has been confirmed by specific site tests, by measuring UBC content from several bottom ash samples before and after the retrofit of a WBAS with the dry MAC® technology. This is clearly a positive contribution to the boiler efficiency increase, since the heat loss associated with the unburned residues in the bottom ash is significantly reduced.
Conducting the calculations according with the ASME PTC 4 code is a time-consuming process, so Magaldi has devised a spreadsheet, containing relevant instructions, formulas and necessary computational procedures. By rigorously following the ASME PTC 4 code to calculate the boiler efficiency variation due to the substitution of a WBAS with the MAC® system, Magaldi has been able to confirm that the dry technology contributes to increase the overall boiler efficiency.

COMPARISON OF HEAT LOSSES AND CREDITS IN BOILER BOTTOM

	WBAS	MAC® / SUPERMAC®
HEAT LOSSES	Sensible heat and chemical energy of the ash crossing the boiler throat (PTC 4 suggested ash temperature: 1100 °C)	Sensible heat content and chemical energy of the ash at the MAC® system ash delivery boundary
	Radiation through the boiler throat (PTC 4 suggested value: 31.5 kW/m²)	Surface heat dispersion (to ambient) from the MAC® extractor casing (including ash hopper) due to radiation and convection
HEAT CREDITS	No heat credit	Sensible heat of the cooling air entering the boiler through the MAC® system



BOILER/COAL - MAIN DATA

Reference Plant		Case A Imported Coal	Case B Indian Coal
Unit Gross Power Generation (Generator Terminals)	MW	550	500
Coal Feed Rate to Boiler	t/h	210	350
Ash	kg/kg	0.15	0.45
Coal High Heating Value	kJ/kg	23028	15488

BOILER EFFICIENCY COMPARISON

With the help of this calculation tool, it is easy to compare the efficiency of a boiler equipped with a WBAS or the MAC® or the SUPERMAC®. As a sample calculation, two 500-550 MW class-boilers, one burning a typical Indian coal [Case A] and one burning an imported coal [Case B], have been investigated. Positive or negative effects on energy savings have been considered for each heat loss and credit. The results are shown in the graph.

The results show that the expected improvement of boiler efficiency, in the range between 0.1÷0.2 per cent for normal bituminous coals and up to or even higher than 0.5 per cent for low-rank coals, can be further increased with SUPERMAC®.

There are a further two points worth mentioning, as both adding flexibility to the power plant operation.

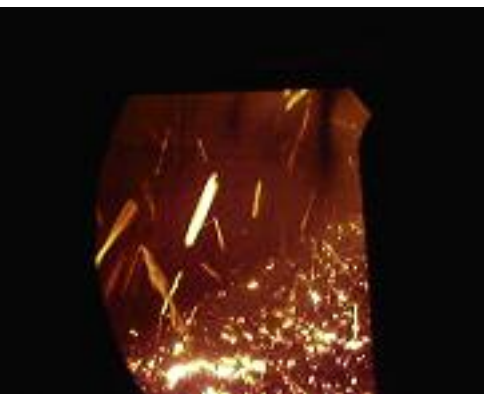
The first is that, if unburned content in bottom ash becomes higher (for instance because of mills wearing or other reasons) the efficiency gain with the MAC® further increases. For example, considering the results of the Indian coal case obtained for 1% of unburnt matter in the bottom ash, the efficiency increase rises from 0.63% to 0.80% in case of 2% unburnt matter, and up to 0.98% in case of 3% unburnt residues.

Second, in cases where this efficiency gain can be converted to power rather than coal saving, the power plant will have additional MWe at zero cost. In case B of the Indian coal boiler, that would mean additional 3.59 MWe at zero cost.

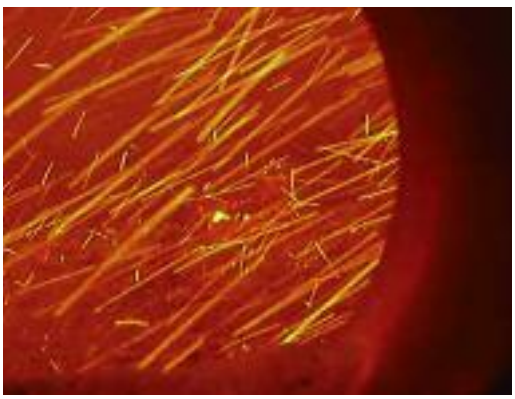
CONCLUSION

A proper integration between the boiler and the dry bottom ash technology optimizes the overall performance, leading to an increase in the boiler efficiency. Relevant savings in terms of coal, auxiliary power consumption, as well as other environmentally important parameters (e.g. carbon dioxide emissions) can be calculated, to quantitatively determine the specific benefits of the dry technology, according with the ASME PTC 4 guidelines.

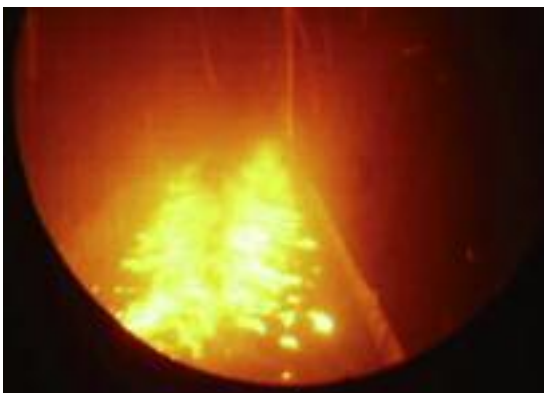
The MAC® and SUPERMAC® dry ash handling technologies are confirmed to support operators and plant manufacturers in their efforts to make conventional coal plants more reliable, flexible and more efficient.



MAC® system with dry bottom ash from only coal.



MAC® system with dry bottom ash from coal with biomass.



MAC® system with dry bottom ash from coal with RDF.

Dry ash handling solution for the Lurgi FBDB™ gasification process

Ganesh Arumugam[1]
Günter Baur[2]
Frederic Judas[1]

1: Air Liquide Global E&C Solutions, Lurgi GmbH, Frankfurt, Germany
2: Magaldi Power GmbH, Esslingen, Germany

This article discusses various ash handling solutions for collecting, conveying, cooling and storing the ash produced by Lurgi FBDB™ gasification technology.
A technical and economical evaluation of ash handling methods is provided. This article concludes by detailing the results of a comparison of wet and dry ash handling solutions.

Air Liquide Global E&C Solutions' Lurgi FBDB™ (Fixed Bed Dry Bottom) gasification technology is one of the leading coal gasification technology. More than 200 gasifiers based on Lurgi FBDB™ gasification technology are currently in operation across the globe. It is a non-slagging, high pressure coal gasification process. It is suitable for all coal ranks, and especially well-suited for coals with high ash and/or high moisture content. In this gasification technology, coal is fed batch-wise into the top of the gasifier, where it undergoes, in sequence, drying, pyrolysis, gasification and combustion processes against a countercurrent flow of high pressure oxygen and high pressure steam (Figure 1).
The raw syngas generated exits the gasifier from the top, and the ash produced is discharged at the bottom. The gasifier operates at a temperature slightly below ash melting point. The ash produced is therefore not molten but slightly sintered.
After depressurization, the ash is discharged from the ash lock as hot, solid particles at approximately 350-400 °C.
Hot syngas exiting the gasifier is cooled, cleaned and conditioned to meet the required product specification. Gas purification units (i.e. Lurgi Rectisol®) recover naphtha as a valuable gasification co-product. The condensates from the gas cooling section are treated to recover further saleable co-products at different stages. The treatments comprise Lurgi GLS™ (Gas Liquor Separation process, tar and oil recovery), Lurgi Phenosolvan® (phenols recovery process), Lurgi CLL™ (Chemie Linz Lurgi process; ammonia recovery) and a waste water treatment unit. This unit recovers nearly 100% of the water, which is then re-introduced in the plant water circuit.
Lurgi FBDB™ gasification is highly energy-efficient. Most of the heat from gasification and combustion is recovered by producing high-pressure steam in the gasifier jacket, and by pre-heating the fresh coal fed into the top of the gasifier. The Lurgi FBDB™ gasification process's efficiency is the highest among competitors, thanks to the heat recovery by the counter-current process and high methane content in the syngas.

All operating Lurgi FBDB™ gasification plants across the globe use the ash sluiceway process as shown in Figure 2. This is a tradi-

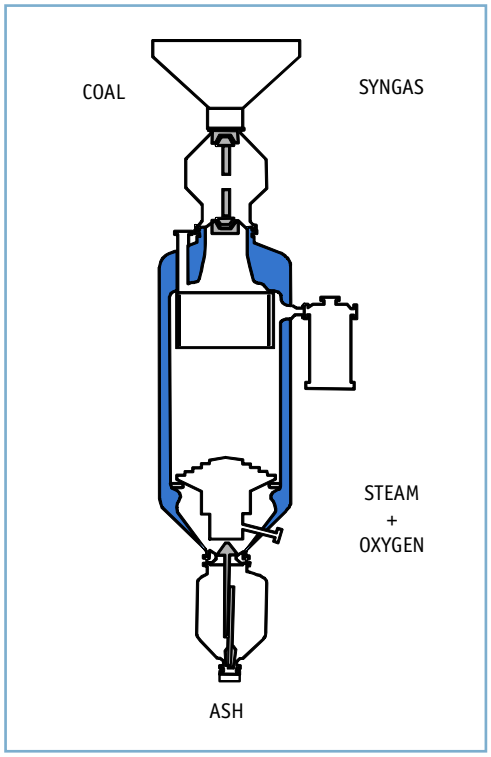


Figure 1: The Lurgi FDBD™ gasification process.

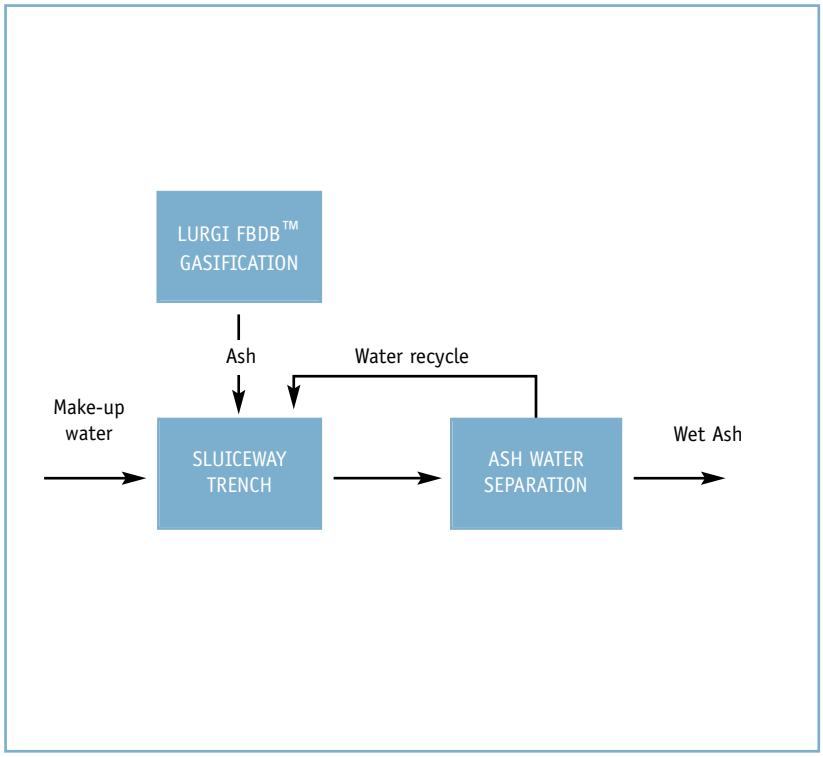


Figure 2: Wet ash sluiceway trench system.

tional, proven wet ash handling solution. It is a water-based ash handling process, and requires a significant flow of water to sweep the ash from the ash sluiceway trench. This trench is a concrete, canal-like structure placed underground exactly below the gasification unit. The ash from the gasification unit is dumped into the ash sluiceway trench batch-wise, where high-pressure water is used to sweep the ash from the bottom of the trench. The ash-water slurry exiting the trench is routed to the downstream ash-water separation unit.

In the ash-water separation unit, ash and water are separated by screens, settlers and filter presses. The clean water from this unit is recycled back to the ash sluiceway trench. The ash leaving this unit is wet, meaning a significant quantity of water leaves the system with the ash. Hence make-up water is required to be supplied to the ash sluiceway trench to make-up for the loss. This wet ash handling solution affords certain benefits that make it highly suitable for the Lurgi FBDB™ gasification ash:

- A proven process
- High reliability and availability
- No ash crushing.

The wet ash sluiceway process is a highly reliable way of handling hot abrasive ash generated during Lurgi FBDB™ gasification process. Experience of operating Lurgi FBDB™ plants suggests that the wet ash sluiceway process availability is close to 100%. Particle size distribution is not a major concern, as the ash-water separation unit removes all large particles at the first stage of screening. Only fine ash water slurry has to be handled in the later stage employed with pumps, settlers and filter press. Hence there is no need for a crusher.

However, the wet ash handling solution is not without its disadvantages. The water consumption of the ash sluiceway is a cause for concern at new plant locations where a significant water flow/resource is not readily available. The operating cost of the wet ash sluiceway process is high due to (i) pumps supplying large quantities of high-pressure water to sweep the ash from the bottom of ash sluiceway trench, and (ii) the need for make-up water. In the ash-water separation unit, the process requires large-capacity of settlers, filter presses and storage ponds to handle the quantity of ash and water. The wet ash sluiceway process therefore needs a significant amount of space. Usage of wet ash as landfill material usually requires a composite lining, which has a negative effect on capital cost.

Although Lurgi FBDB™ gasification is a proven chemical-industry technology, its wet ash application is relatively undeveloped. The possibility of heat recovery from the hot ash has cleared the way for the development of alternative solutions, which will further increase the efficiency, economics and water footprint of the Lurgi FBDB™

gasification plant. Therefore, Air Liquide Global E&C Solutions investigated for an alternative solution to meet current market and customer needs:

- Reduce water footprint
- Eliminate the ash slurry separation unit
- Improve operating costs (utilities and maintenance)
- Develop dry ash as a co-product
- Recover heat from the hot ash.

The ash produced during the Lurgi FBDB™ gasification process is different from ash produced by coal-fired boilers in terms of particle size distribution (PSD), temperature, hardness and abrasion index. Coal-fired boiler plant ash particles are typically smaller in size, hotter and less abrasive than FBDB™ ash. Table 1 shows typical ash properties from Lurgi FBDB™ gasification process.

ALTERNATIVE SOLUTIONS

Multiple solutions for handling ash under completely dry conditions already exist; in coal-fired boilers there are proven methods for collecting, conveying, cooling and storing bottom ash.

Air Liquide Global E&C Solutions has evaluated the suitability of these solutions for handling ash from Lurgi FBDB™ gasification process. After studying the market, Air Liquide Global E&C Solutions selected three dry ash handling processes suitable for handling Lurgi FBDB™ gasification ash. These are listed below (Figure 3):

Solution I: In this solution, ash from gasification is collected and transported in a cooling screw conveyer. The conveyor has a water cooled jacket. Indirect contact between cooling water and ash across the jacket cools the ash. The cooled ash leaves the screw conveyor at the other end, and is fed onto another conveyor to be transported directly to storage silos. The ash is periodically emptied from the storage silos for further treatment or disposal.

Solution II: In this solution, a special conveyer – typically used to collect bottom ash from coal-fired boilers – receives and conveys the ash from the gasification process. These special conveyors cool the ash during transportation. Inside the conveyer, air is blown over the ash bed on the conveyer plates counter currently. This results in direct contact cooling of ash by air.

The end of the conveyor is elevated, and the ash is fed directly into the storage silos.

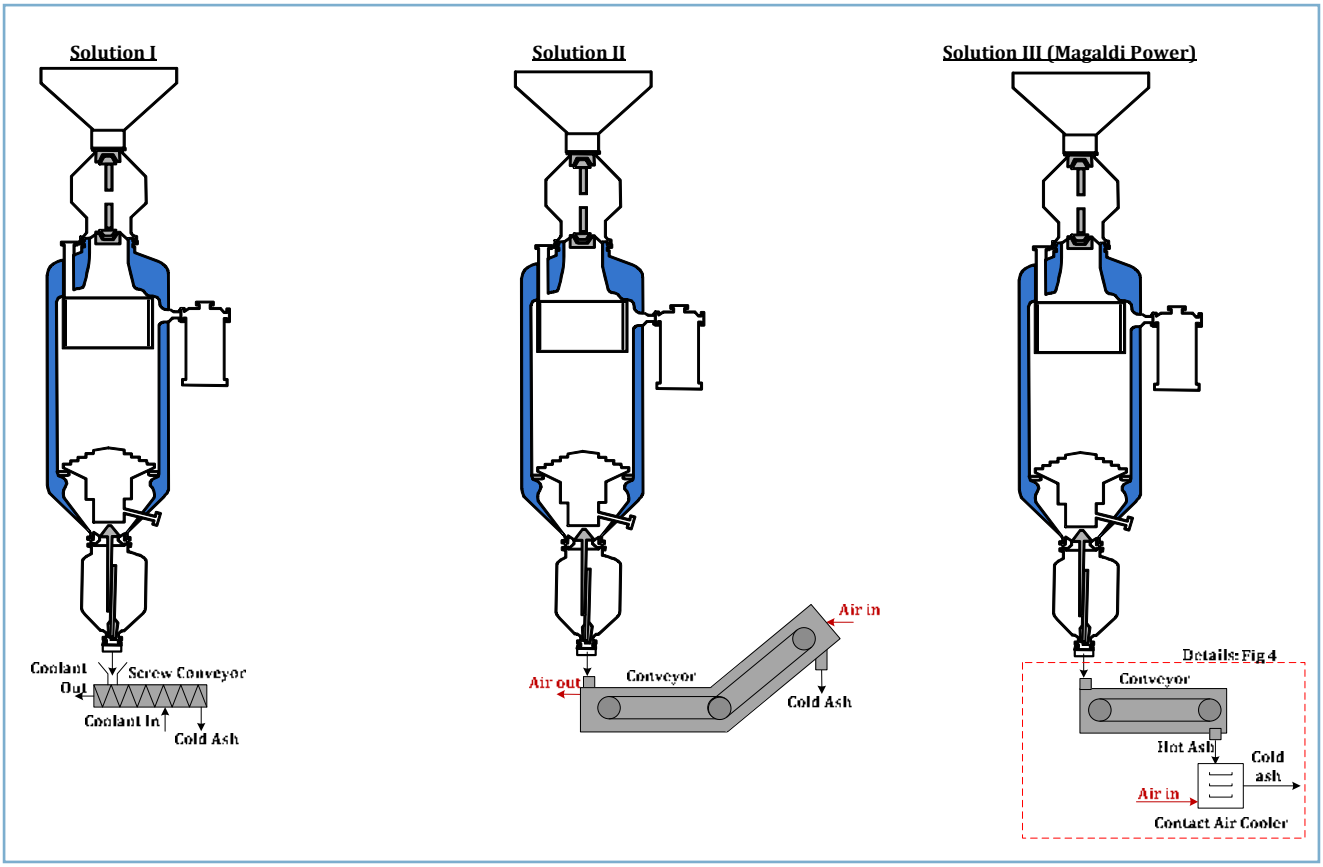


Figure 3: Dry ash handling methods.

Solution III (Magaldi Power): In this solution, the ash from the gasification process is collected and transported in a special stainless steel conveyor designed to handle high-temperature ash. The hot ash is transferred to contact coolers, where it is cooled by direct contact with air. Once cooled, the ash is conveyed to storage silos by bucket elevators.
All three of these solutions have advantages and disadvantages. In this paper, Air Liquide Global E&C Solutions examines solution III in detail. The Magaldi Power dry ash handling solution was found to provide the most competitive total cost of ownership (OpEx and CapEx), in combination with high reliability and fulfillment of risk evaluation criteria.

MAGALDI POWER DRY ASH HANDLING PROCESS

The Magaldi Power (MP) Group, headquartered in Salerno, Italy, is one of the world's leading specialists in hot bulk materials handling in power plants, cement industries, steel mills and metallurgical and mining companies. MP has developed a unique solution for handling ash from Lurgi's FBDB™ gasification process employing proprietary equipment (Figure 4): Ecobelt® extractors, Ecobelt® conveyors and Contact Cooler.
Firstly, the ash produced by the Lurgi FBDB™ gasification process is received by Magaldi Ecobelt® extractors. These are steel-mesh belt conveyors, completely enclosed in dust-proof steel casing to avoid any leakage of ash or gas into the atmosphere. They are designed to extract high temperature ash from gasifier. They are insensitive to particle size, with minimum wear, power demand and noise emissions. The hot ashes from the Magaldi Ecobelt® extractors are then transferred to Magaldi Ecobelt® conveyors. These are steel belt conveyors, and they are also enclosed in a dust-proof steel casing – for the same reasons as the extractors. Ecobelt® conveyors are able to transport material over long distances and are able to lift the material. The availability of these conveyors is >99.6% thanks to the damage tolerant design of MP special steel belt with mesh and pans. Hot ash from Ecobelt® conveyors is then transferred to ash crushers to limit the particle size (typically to 80 mm). The crusher has a relatively low capaity and is inexpensive. As the quantity of raw ash with particle size of more than 80 mm is less than 5% of the total by weight, power consumption is less. After crushing, the ash is transferred to Magaldi Contact Coolers.
For maximum cooling efficiency, 80 mm is the largest particle size allowed inside the Contact Coolers. In the Contact Coolers, ash is cooled to 100-150 °C by direct contact with air. The cooled dry ash is then transferred by bucket elevators to the top of the ash silos. The ash silos are periodically emptied from below onto trucks. The ash can then be utilized, e.g. as landfill material, or as a commodity input in the cement/brick industry. A small quantity of air is circulated

Conditions:	Unit	Value
Normal temperature	°C	350-400
Pressure	Bar abs	1
Specific heat	kJ/kg °C	1.2
Bulk density (Dry)	kg/m³	860-1050
Void space	%	Approx. 50
PSD:		
0-25 mm		69.20%
25 mm - 100 mm		30.80%
Composition:		**dry, wt%**
SiO_2		30-50%
Fe_2O_3		20-40%
Al_2O_3		20-40%
CaO		0-20%
MgO		0-10%
Others		1-5%

Table 1: Typical ash properties.

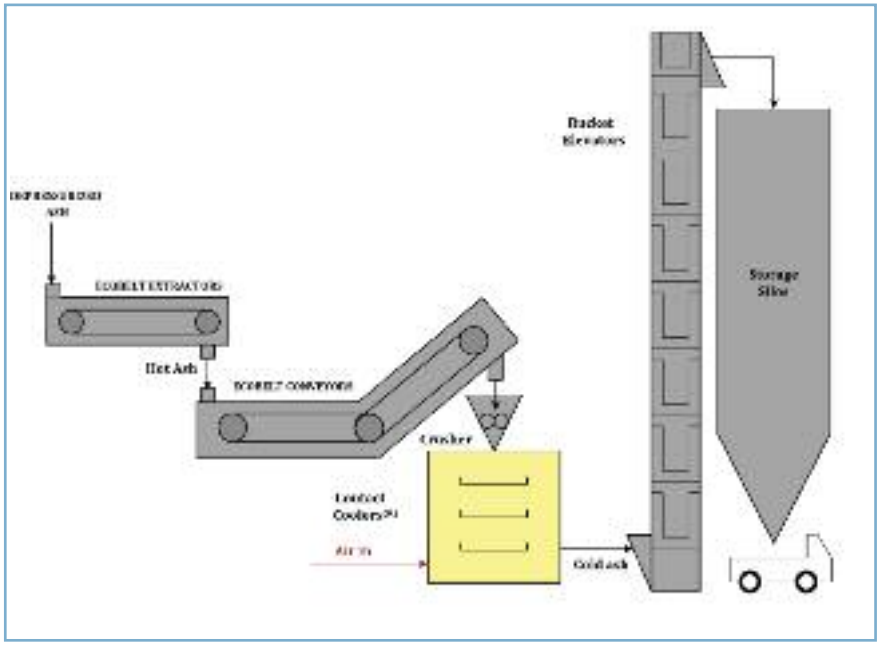


Figure 4: Magaldi Power ash handling process.

inside the Magaldi Ecobelt® extractors and conveyors to avoid any accumulation of flammable gas.
The circulation air from the extractors and conveyors, and the air from Contact Coolers is sent to a bag filter system to remove dust particles. Then the dust-free hot air can either be sent to heat exchanger to recover the heat with boiler feed water/process stream or vented directly into the atmosphere.

TECHNICAL ADVANTAGES

- Zero water consumption
- Low operating cost
- No effluent water treatment
- Dry ash available for valorization: cement/brick industries/road construction
- Simple solution based on conveyors
- Heat recovery from hot ash
- Higher reliability and availability as wet ash handling system
- Easy operation and maintenance
- Referenced design with coal fired boiler plants.

ECONOMIC ADVANTAGES

The commercial details of this solution from Magaldi Power have been evaluated by an expert team at Air Liquide Global E&C Solutions. The results are as follows:

- Assuming that no ash is salable to brick/cement manufacturing industries, MP ash disposal cost (Note 1) is 5% lower than the wet system ash disposal cost.
- Assuming that 10% of total ash is salable to brick/cement manufacturing industries, MP ash disposal cost is 11% lower than the wet system ash disposal cost.
- MP plot area requirement is 65% lower than the wet ash system plot area requirement.

Note 1: Disposal cost is the total cost required to collect, convey, store and dispose ash, taking into account the following:

- Total operating cost
- Total investment cost
- Structure cost due to increase in gasification unit elevation to accommodate dry ash system at its bottom
- Dust handling system
- No heat recovery.

CONCLUSION

Air Liquide Global E&C Solutions has extensively researched the development of an alternate solution for handling ash from Lurgi FBDB™ gasification technology. It is possible to conclude from this study that there are multiple solutions available on the market that can competitively handle Lurgi FBDB™ ash under dry conditions, while preserving current levels of reliability and technology risks. Air Liquide Global E&C Solutions determined that Magaldi Power dry ash handling technology is the best solution due to its technical and economical advantages over the other investigated solutions.
Air Liquide Global E&C Solutions is currently working on additional optimization methods to enhance the competitiveness of the dry ash handling solution for the Lurgi FBDB™ gasification process.

CONTACT DETAILS

Frederic Judas
Director, Coal to Gas Product Line
Ganesh Arumugam
Process Engineer,
Coal to Gas Product Line
Air Liquide Global E&C Solutions
Cryogenics & Lurgi Technologies
Lurgi GmbH, Frankfurt, Germany.
Günter Baur
General Manager
Magaldi Power GmbH
Esslingen, Germany.

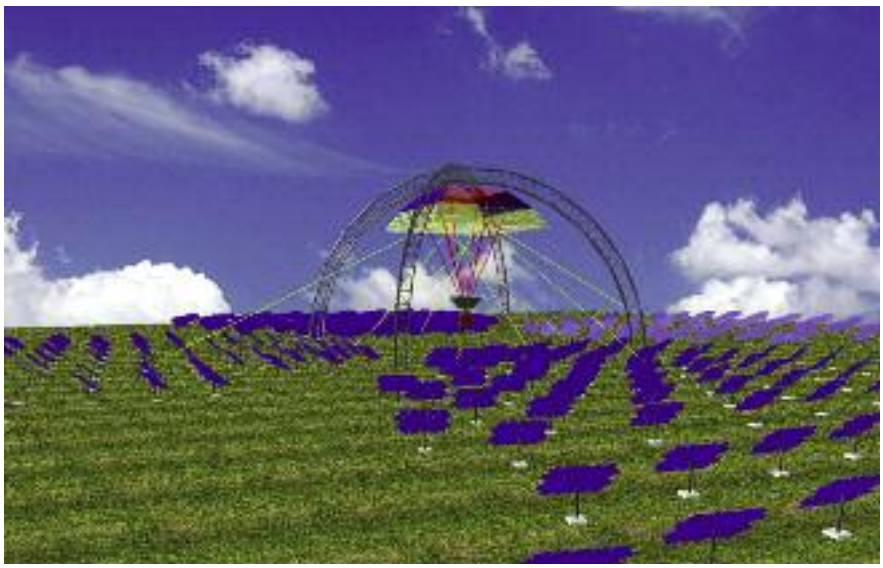
STEM®:

All clean energy you need where and when you want

by **Gennaro De Michele**, *STEM® Scientific Consultant* gennaro.demichele@gmail.com
by **Mario Sica**, *Business Development Manager* mario.sica@magaldi.com

In today world renewable energies are of primary importance and sun is the most powerful, economical and endless source of energy: therefore many worldwide companies explored the way to transform such energy into electricity. Magaldi has developed a modular system, called STEM® (Solar Thermal Electrical Magaldi) to collect the solar energy - through a solar field, made of heliostats - into a secondary reflector that concentrates such energy in a receiver to be used immediately or stored to be extracted when desired, also H24. Each module, called SGU (Solar Generation Unit), is rated 500 kWe and consists essentially of:

- an optical system based on a beam down configuration that allows the transfer of the radiation captured by a traditional



Artist view of SGU-STEM Plant.

STEM® receiver.

solar field to the receiver, positioned on the ground
- a sand fluidized bed receiver that captures the solar radiation to immediately use or store it.

The aggregation of more than one module may generate a quantity of steam to be used in industrial processes or, with a power block, to generate electrical power.

The heliostats are provided with a special design aimed to reach high performance and precision with low costs: an accurate solution, based on two-axis tracking system and a special control system able to perform on-line the correction of the aiming in order to compensate any mismatch induced by mechanical backlash, wind or other external causes, address with high precision the sun energy towards the secondary reflectors located into the tower and reflect the solar energy down to the receiver.

The receiver is based on fluidized bed technology whose characteristics appear ideal for creating systems that need to exchange, transfer and store heat. The bed material is common silica sand, a low cost material. The receiver is made of a cylindrical cavity for solar radiation collection and is surrounded by a fluidized bed that absorbs the solar energy and transfers the heat from the cavity to the inner part of the receiver. The bed may also be powered by burning natural gas directly with a further increase of the system generation flexibility.

A pilot plant was built at the Magaldi factory in Buccino (Italy) in 2012 and extensively tested: the unit, rated 100 kW thermal, confirmed the expected performance and showed excellent and promising results. Next future steps are the full exploitation of this technology meanwhile, a fully sized prototype of the modular SGU will be manufactured and installed in an Italian location.

The simplicity of STEM® design – only glass for mirrors, steel for structural parts and sand for storage - coupled with the modularity concept will allow the reduction of the manufacturing cost .

STEM® is a very flexible and environmental friendly system to produce electric power and may be used, when remote sites are not connected to the grid. In sunny locations, SGU modules may be combined together to generate all the energy required around the clock.

Mexico

Breakthrough technology on casting cooler

by **Monica Di Domenico**, *Senior Process Engineer* monica.didomenico@magaldi.com
by **Antonello Marrazzo**, *Sales Area Manager* antonello.marrazzo@magaldi.com

In green sand foundries the cooling of castings downstream on the molding line has always posed difficulties, due to the high volume and speed of the production line.

Drum, vibrating cooler and carousel are all cooling solutions, but now Magaldi has opened a new frontier on casting cooling solutions with the installation of the Magaldi Casting Cooler (MCC®) system in an important Mexican foundry: Tisamatic.

Tisamatic is a green sand foundry based in San Luis Potosi producing a wide range of castings for the automotive and home appliance sector. Tisamatic is part of Grupo Industrial Saltillo (GIS) and it has been going from strength to strength due to the excellent quality of its castings and the application of world class technology in its facilities.

In September 2013, two new green lines were adjoined to the existing ones for the production of grey and ductile iron castings. These were equipped with Magaldi's Casting Cooling solution based on the Magaldi Superbelt® "P type" technology. The Magaldi Superbelt® "P type" has been designed to withstand high mechanical impact caused by heavy material, weighing hundreds of kilograms. It is capable of horizontal and inclined transportation (up to 35°) of heavy material, including castings, sprues, forgings, scraps and crop ends.

This technology is usually used in foundries for the transportation of castings at the outlet of Didion drums, shake-outs or vibradrums

Casting cooling and degating on the Superbelt®.

where resistance to shock loads generated by hammers, air cannons or manipulators during the sprue removal operation is off paramount importance.

Magaldi's application focuses on and manages the cooling and transportation of castings to the shot blasting machine as well as of the transportation of runners, sprues and gates after de-gating operations are performed by operators.

The MCC® system along with the Magaldi Integrated Supervision System (MISS®) is able to optimize the cooling performance for each different type of production and to minimize the energy consumption for cooling processes.

Magaldi's solution at Tisamatic includes two parallel Magaldi Casting Coolers, SUP01 and SUP02 for cooling and transporting the castings and sprues, coming from the two molding lines.

Both Magaldi Casting Coolers are fed by a short vibrating feeder installed downstream of the shake-out lines. The short vibrating feeders allow for the correct distribution and placement of castings on the MCC® to comply with the resident time identified for each group of castings.

Both SUP01 and SUP02 are equipped with a forced cooling tunnel, 35 meters long that is held under negative pressure. The air flow through the tunnel is sucked from the central duct and is forced to enter from the extremities, after which the uncovered remaining length allows operators to de-gate cooled castings and to sort sprues by sliding them down through the MCC® lateral slides onto two parallel Magaldi Superbelt® conveyors (codes SUP03 and SUP04) placed below the Magaldi Casting Coolers.

The Magaldi Superbelt® conveyor's low speed along with the special configuration of their carrying plates (Magaldi belt type PR) makes the Magaldi Casting Cooler a great flat work surface for the operators de-gating cold castings on it and ensuring easy sorting and dragging of the sprues/gates toward the lateral chutes.

The cooled and de-gated castings are then conveyed to the blasting machine while the SUP03 and SUP04 convey the sorted sprues to the crushers (out of Magaldi scope) and downstream, via two Magaldi Superbelt® conveyors coded SUP05

and SUP06. Sprues are then unloaded to dedicated containers.
The MCC® in conjunction with the Magaldi Integrated Supervision System (MISS®) manages and controls the cooling air flow depending on inlet casting temperature and varying the belt speed according to the scheduled ID type of casting to be cooled.
The MISS® interfaces with optical pyrometers placed along the cooling tunnel, receives ID castings data coming from the molding line along with all the status signals of the Magaldi installation in order to manage and control cooling and conveying processes according to the customized logical design.
The MCC® offers Tisamatic the following main advantages compared to a traditional vibrating cooler:

- Better dependability
- Guaranteed cooling
- No vibrations, no dust, no noise
- No foundations required
- Low spare parts requirements
- Low and flexible energy consumption (according to the molding line upstream)
- Ability to reach steep inclinations (up to 35°)
- Ability to perform cooling and de-gating activities on the same conveyor.

EQUIPMENT DATA

MCC® belt Type	PRD.AC.1620.068.V
Superbelt® Type	PD8.AC.0800.108.V
Center distance	
MCC® #1	52000 mm
MCC® #2	52000 mm
Magaldi Superbelt® #3	18000 mm
Magaldi Superbelt® #4	18000 mm
Magaldi Superbelt® #5	50000 mm
Magaldi Superbelt® #6	45000 mm

PROCESS DATA

Material	Castings, runners and sprues
Capacity MCC®	16 t/h
Magaldi Superbelt®	9 t/h
Inlet Temperature	650 °C
Outlet Temperature	less than 70 °C

Mexico

An Italian corner in Mexico: casting cooling in Blackhawk foundry

by **Antonello Marrazzo**, *Sales Area Manager* antonello.marrazzo@magaldi.com

More and more Italian is spoken in the Mexican foundry Blackhawk de Mexico, based near Monterrey, after the last investment that finalized their expansion project for a no-bake foundry: the Magaldi Casting Cooler (MCC®).

"We decided to increase our capacity by approximately 50% with a new no-bake facility making bigger castings for important brands like John Deere, Dana, Conmet, ecc." said Patricio Gil, CEO of Blackhawk de Mexico, during the inauguration of the new foundry held in March 2014. [Patricio Gil is prominent in the foundry industry and President of the DIS (Ductile Iron Society)].

To achieve this capacity increase a new foundry was built adjacent to the existing facility. Installations include a no-bake molding line, electric induction melting and a manual finishing department. The net production capacity has now reached 37500 metric tons per year.

Patricio, who is as professional as friendly, quipped: "I like Italy, Italian food and I very much appreciate Italian technology so we have decided to buy almost all the equipment from Italy: we have bought the molding line from IMF, the shot-blasting machine from Banfi and we have got the casting cooler from Magaldi!" Smiling he adds: "I believe now we are almost obliged to offer a good Italian espresso coffee to our clients when they are visiting the new foundry!"

The Magaldi Casting Cooler has been installed to convey automotive items such as motor supports, and gearboxes. The maximum castings size is 1.4 m x 1.1 m x 0.8 m with a maximum weight of 400 kg.

The Magaldi Casting Cooler is equipped with a cooling tunnel, held under negative pressure, in which a stream of cooling air flows at controlled speed to avoid thermal shock to castings. Ambient air is sucked from the centre of the cooling tunnel and is forced to the extremities of the cooling hood.

The cooling of these castings is performed on two separate coolers "MCC01" and "MCC02". The castings are loaded by crane from the shake-out and then unloaded onto the MCC01 belt.

The operators carefully place two castings in parallel on the belt width in order to maximize the cooling time inside the tunnel. The castings are then cooled on the MCC01 and then transferred to the MCC02 trough a special damped chute.

The drums of MCC01 are 300 mm in

EQUIPMENT DATA MCC01

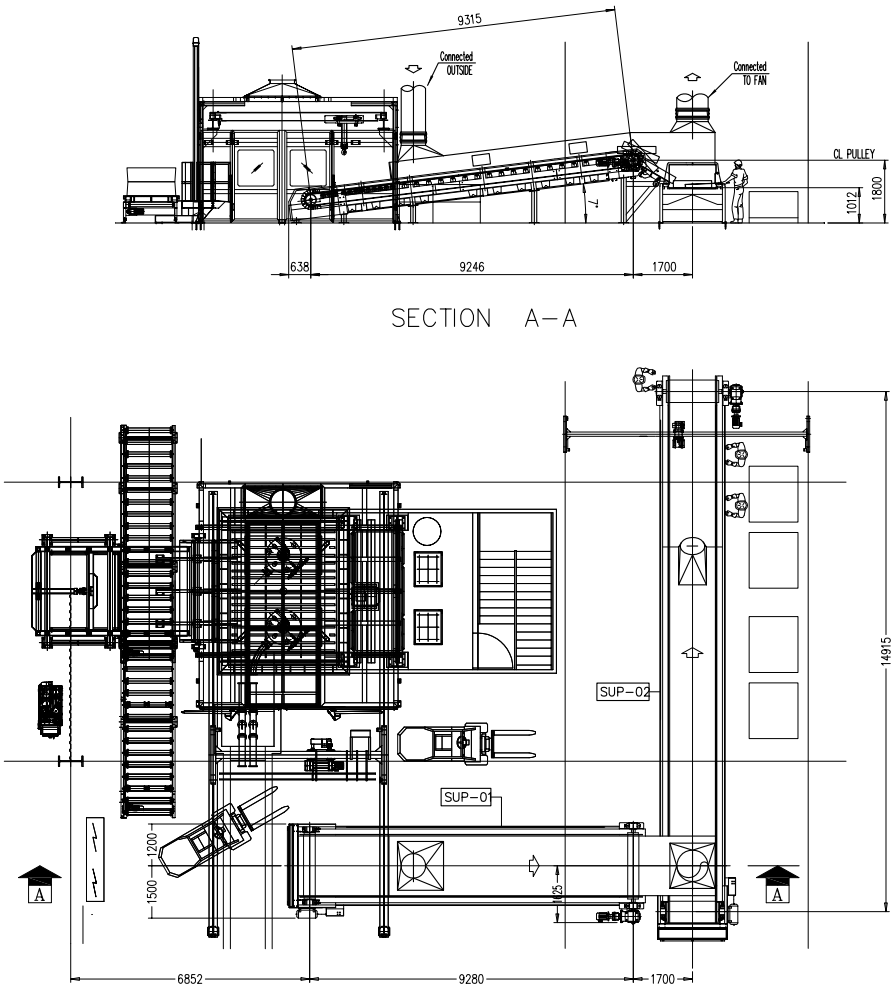
Superbelt® Type	PD/MN.1806.106.S
Center distance	9315 mm
Width	1800 mm
Installed power	0.25 kW

EQUIPMENT DATA MCC02

Superbelt® Type	PD/MN.1408.108.S
Center distance	14915 mm
Width	1400 mm
Installed power	0.25 kW

PROCESS DATA
(for both Magaldi Casting Coolers)

Material	Castings with runnings and sprues
Capacity	6 t/h
Temperature	from 400 °C to less than 90 °C
Max weight	400 kg



MCC® system at Blackhawk foundry.

diameter only, in order to minimize the drop between the two conveyors during the unloading of the castings. The dampened chute assists a smooth unloading. The MCC® conveyors are also equipped with closer pitch idlers at the loading areas in order to enhance the loading capability and the resistance to shock loads

Once the castings are unloaded onto MCC02, the cooling process proceeds so castings leave the hood at 90 °C. An important characteristic of the system is that with two possible settings, energy can be saved based on seasonal variations. In summer, when the ambient temperature is higher, the energy consumption of the venting system is the maximum needed to reach the expected castings temperature of 90 °C. In winter, when the ambient temperature is lower, the system automatically changes the setting parameters of the MCC® (belt speeds, fan speeds, etc.) so that it can achieve the same cooling temperature, but with higher energy savings.

At the exit of the cooling tunnel operators at both sides of the conveyor can perform the degating activities and are able to load by crane the carousel of the shot-blasting machine.

With reduced noise levels and in the absence of vibration, the activity of sprue removal becomes easier and safer for operators.

With the MCC®, Blackhawk can achieve the optimal temperature for castings and minimize the handling of the castings after the shake out. This gives significant potential for increased productivity especially when compared to the previous system whereby the foundry used natural cooling techniques to cool the castings in racks. Natural cooling would have taken around 6 hours. Now with the MCC® this has been reduced to 1.5 hours.

The belt of both MCC® conveyors is manufactured in Hardox steel of extreme strength, so the longevity of the belt is increased. Magaldi have guaranteed these belts for 3 years, however the belt life expectancy is much closer to 10 years.

Blackhawk de Mexico already started the foundry commissioning meanwhile the MCC® system will be commissioned in August 2014.

P.R. of China

Bradken Ltd a brand new foundry in China

by **Alberto Lalia**, *Area Manager* alberto.lalia@magaldi.com

Bradken Ltd is a prestigious supplier of castings for the mining industry. It specializes in wear resistant castings for digging, excavators, dumper spoons and teeth and in addition to its 16 foundries worldwide, Bradken also offers engineering and machining services.
Bradken's continuous research into new technology for wear resistant material has seen the company become the worldwide leader in this market. Technology and experience allow Bradken produce high quality castings at competitive prices.
Here we look Bradken's latest development – a new foundry in China. The new foundry is located in Xuzhou, a typical Chinese industrial area developed with the help of the Chinese government in close collaboration with Bradken management.
For the mining sector, large wear resistant castings are difficult to produce, however these are exactly the products that Bradken is now producing in this new foundry, with the use of a moulding line and chemical sand.
The foundry required a dependable system that:

- could convey hot sand
- was robust enough to handle extreme conditions
- had minimum maintenance requirements
- could be installed in a space restricted area.

Traditional methods to convey hot sand after the shake-out include

Ecobelt® tail section.

rubber belt conveyors or coolers/classifiers with associated pneumatic conveying systems. However, such traditional systems poorly handle high temperature materials, suffer from wear, are difficult to be operated due to inhomogeneous materials and sharp/hard particles and involve frequent maintenance interventions and high O&M costs.
Magaldi Industrie's solution was to install a Magaldi Ecobelt® conveyor, that ensures safe, continuous and reliable operation thanks to its unique damage-tolerant design and its completely enclosed air-tight casing preventing dispersion of fines into the environment.
Two large vibrating tables separate the sand from the casting, each one discharging 40 t/h of sand.
Just underneath these two shake out tables the Magaldi Ecobelt® conveyor is equipped with an automatic sand recovery system - the Magaldi O-Chain conveying hot sand at a rate of 60 t/h, 24 h/day, though peaks of up to 80 t/h have occurred. The material is then transported by the Magaldi Superbelt® conveyor at a temperature of 315 °C (600 °F) to the downstream cooling system.
The Magaldi Ecobelt® was successfully commissioned in the summer of 2012 with high customer satisfaction and in compliance with the required quality standards. The Ecobelt® system operates reliably and safely, with minimal inspection, cleaning and maintenance requirements.

Short interview with
Kevin Gilbert – Project Leader Xuzhou Foundry

What were the main factors that led Bradken to select a Magaldi Ecobelt® conveyor for this foundry project?
Its reliability and high temperature capabilities.

What were the features/advantages offered by the Magaldi Ecobelt® conveyor that Bradken considered of most interest for this foundry line?
High temperature capabilities, reliability, vertical lift, dust control, tail pulley spillage recovery conveyor.

Would you recommend the Magaldi Ecobelt® conveyor to the management of other foundries?
Yes.

TECHNICAL DATA

Length	32 m
Belt width	1200 mm
Installed power	7.5 kW
Material	Hot chemical foundry sand
Capacity	80 t/h
Temperature	600 °C
Grain size	Fines up to 200 mm

Canada

A challenging experience: the heaviest Magaldi Superbelt® HD conveyor application for scrap transportation

by **Alfonso Pirro**, *Area Manager* alfonso.pirro@magaldi.com

In mid 2012 Tenova Core, one of the most important worldwide suppliers of advanced technologies, products and engineering services for the Iron & Steel industries, contracted Magaldi Industrie S.r.l. the supply of two Magaldi Superbelt® HD (Heavy-Duty) scrap conveyors.

With a long history of providing robust and reliable solutions to some of the largest foundries, mining and steel mills in the world, Magaldi Industrie S.r.l. has again designed, manufactured, commissioned and started-up two Magaldi Superbelt® HD (Heavy-Duty) conveyors to Tenova Consteel and their Ivaco Rolling Mills steel factory in Canada a 24/7 scrap metal processing facility.

Ivaco Rolling Mills (IRM) is a steel recycling facility located on the banks of the Ottawa River in L'Orignal, Ontario (Canada) between Montreal and Ottawa. From metal scrap IRM produces steel billets and hot rolled wire rod to supply both the domestic and international markets. The scrap metal is delivered to a huge scrap bay located next to the melt shop. Scrap comes in two main grades: shredded (Picture 1) and heavy large slabs and beams (Picture 2), along with some direct reduced iron (DRI) or pig iron for Electric Arc Furnace (EAF) chemical balance. A Tenova Consteel slip-stick horizontal conveyor pre-heats and feeds the metallic charge to the EAF.

At the beginning of 2012 Tenova required a dependable system with low maintenance requirements to convey 200 t/h heavy scrap in a tough environment. Tenova needed a system for continuous fixed scrap volume layer loading and at the same time wanted to eliminate the high operating costs associated with the traditional furnace bay crane activities using charging buckets.

Magaldi Industrie Srl proposed the installation of two parallel Magaldi Superbelt® HD conveyors, P type – 1800 mm wide steel pans made of 8 mm thickness anti wear Hardox

Picture 1.

Picture 2.

400. The unique damage-tolerant design of the Superbelt® allows to manage heavy loads and withstand high impact forces whilst ensuring safe, continuous and reliable operation.

The Superbelt® HD special design eliminates any risk of sudden failures, often associated with other conveyors in the heavy scrap metal management industry. Wear is negligible since material is conveyed slowly, with no relative motion against steel parts. One unique construction features of the Magaldi Superbelt® is to have the plates attached directly to a multi link steel wire mesh supported by idlers. Even if part of the Superbelt® steel mesh is damaged the conveyor will not stop: it is possible to wait until the next scheduled shutdown for any maintenance activity.

In mid 2012 Tenova Core awarded the contract to Magaldi Industrie S.r.l.

Since May 2013, each Magaldi Superbelt® HD scrap conveyor perpendicularly feeds scrap onto the downstream Tenova slip-stick conveyor with a throughput of 100 t/h via batch loading through a weighing and loading device. Both conveyors are loaded by a magnet from the scrap bay by a receiving hopper fitted with hydraulic "clamshell" doors mounted over the Superbelt® loading section. It receives up to 5 tons (approx. 5 cum) per shot each minute (the magnet cycle time is about 1 minute) from an approximate height of 1.2 meters. The cluster released by the magnet often discharges onto the Superbelt® conveyor large beams of 1.5 x 0.5 x 0.5 meters in dimension and weighing approximately 300 kg each. To withstand this tough scrap handling environment the loading section of the Magaldi conveyors and the Superbelt® HD conveyor itself have been designed and manufactured of robust construction. Specifically, the double row supporting idlers frame has increased strength and rigidity while the horizontal loading section, approximately 6 meters long just after the tail section, has been equipped with:

- 300 mm high partially overlapped sidewalls to prevent shredded parts or scrap touching the idlers rotating underneath
- reinforced rubber lined supporting idlers across its entire width, mounted on a heavy shock load absorber frame
- patented lateral skirtboards to prevent any scrap overflow during the magnet unloading.

Each conveyor features 32 meters drums center distance with an

Magaldi Superbelt® HD handling steel scraps.

inclined section of 22.5° rising up to a discharge height of 31.3 meters from the ground, supported by a steel structure with double maintenance walkways along the inclined section of the conveyor.
Particular attention has been given to layering the scrap on the downstream slip-stick conveyor to ensure good furnace operation, thus the Magaldi conveyors are electric motor driven through a shaft mounted gearbox and a frequency converter in order to set the correct speed. Indeed, the EAF charging is one of the most complex operations and depends on the dimensions as well as the density of the different scrap metal. For this reason the weighing device upstream of the Superbelt® conveyor helps to coordinate EAF energy usage with the adjustable scrap feed rate.
Finally, a radioactive scrap detector is installed just after the loading section to allow the scrap layer to be accurately checked for radioactive materials.
The results of these first months of operation have been very satisfactory. The installation of Magaldi Supebelt® HD conveyors confirms many benefits in terms of continuous scrap feeding, high dependability, simplification of the steelmaking logistics by minimizing the scrap movements, low Operation & Maintenance cost and have met the requirements of IRM steelworks facilities.

EQUIPMENT DATA

Superbelt® Type	PD/MN.1808.308
Center distance	32460 mm
Width	1800 mm
Installed power	15 kW (20 HP)

PROCESS DATA

Material	Scrap
Capacity	100 t/h
Temperature	ambient
Max weight	5 tons by magnet or grapple

Canada

Red Rain transportation in a Canadian rolling mill

by **Alberto Lalia**, *Area Manager* alberto.lalia@magaldi.com

Arcelor Mittal Dofasco is an integrated steel mill which has been operating in the Hamilton region of Canada since 1912, when C.W. Sherman founded the Dominion Steel Casting Company to manufacture castings for Canadian railways.
Later named Dominion Foundries and Steel, the company merged with its subsidiary, Hamilton Steel Wheel Company in 1917. The name was officially changed to Dofasco Inc. in 1980. Dofasco fired up the first universal steel plate mill in Canada and in 1954 was the first company in North America to adopt basic oxygen furnace technology. In 1996, Dofasco introduced an electric arc furnace and slab caster, the first of its kind for any fully-integrated steelmaker on the continent. In 2006, Dofasco was purchased by Europe-based steelmaker Arcelor. During this transition, Arcelor merged with Mittal Steel to become ArcelorMittal. Today ArcelorMittal is the world's largest steelmaker accounting for nearly 10% of global steel production.
Magaldi has been asked by Arcelor-Mittal Dofasco (AMD) to investigate the possibility of replacing a shaking table conveyor for hot scales transportation, as a part of a wider project to make energy savings in the plant.
Arcelor Mittal Dofasco Inc.'s existing shaker table designed for dry scale removal during the rolling process is a significant contributor to energy consumption due to the use of compressed air as operating medium. The purpose of the new project is to replace the existing pneumatic shaker tables, containing pneumatic cylinders and springs, with an energy efficient conveyor belt mechanism. The project objectives are to reduce energy consumption by reducing compressed air demand and increase operating hours and efficiency.
Located in a tunnel below the runout tables in the Hot Mill Plant are 27 shaker tables in continuous operation. To ensure that no surface defects occur during the rolling process, it is critical that the scale (iron oxide) formed during the heating process falls off the product onto the shaker tables. Before this occurs, the table rolls remove scale from the bottom of the slabs, which then falls onto the shaker table. This is referred to as "red rain" as it can reach extremely high temperatures,

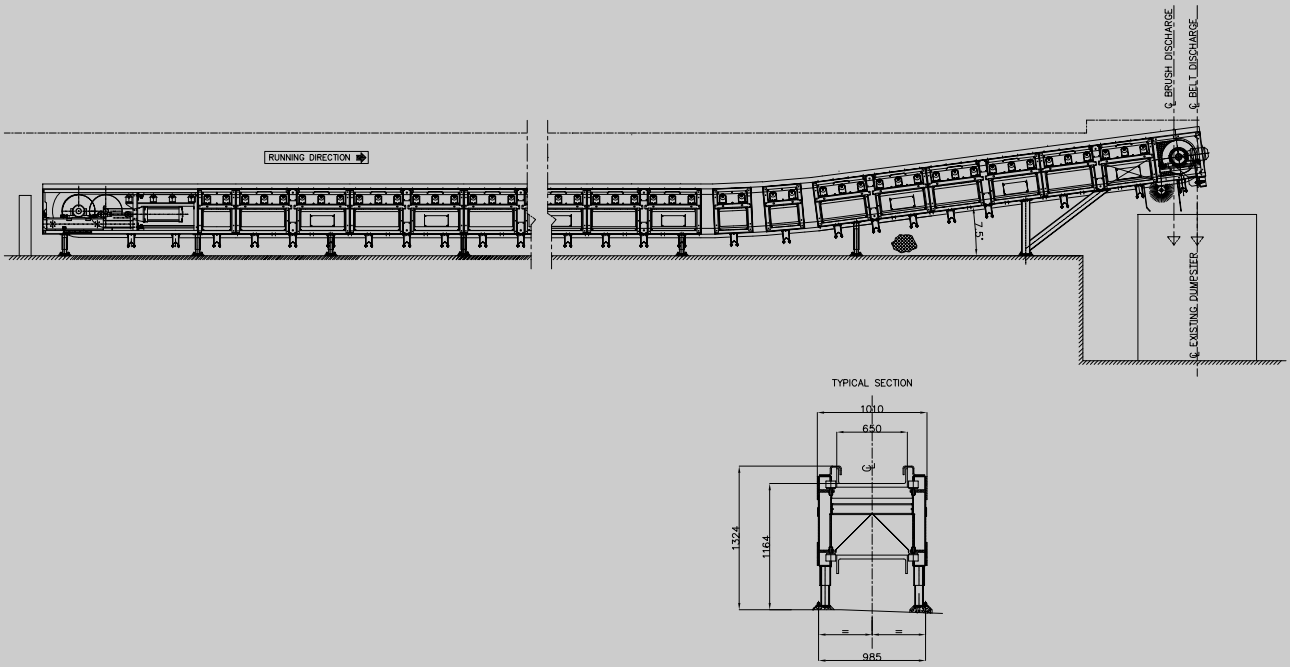
Electric Arc Furnace.

TECHNICAL DATA

Length	99.4 m
Belt width	650 mm
Installed power	4 kW
Material	Hot scales
Capacity	3 t/h
Temperature	1000 °C
Grain size	Average 80 x 80 mm

Magaldi Superbelt® head section.

up to 1000 °C. The scale then falls into a scale pit at the end of the shaker tables, where it is then dropped into a scale transfer car.
The estimated amount of scale moved is approximately 3 tonnes per hour, 7016 hours per year, including scheduled maintenance shutdowns. The current air consumption has been measured at 3400 m^3/h.
Magaldi's technical department found a solution to the main issue of energy consumption with the installation of a Magaldi Superbelt® conveyor approximately 90 meters long capable of conveying the hot scales up to the discharging beam. The total energy consumption of the Magaldi Superbelt® conveyor is only that of a 4 kW electric motor - a significant energy saving compared to that of the existing 27 shaking tables.
Project development is very challenging because the site is confined. The Magaldi Superbelt® conveyor will be installed in a long pit located underneath the rolling line. A tight erection period of only 4 days requires the Magaldi Superbelt® conveyor to be preassembled in sections of about 6 meters and then be exactly positioned by crane into the pit. This working procedure will be coordinated by two experienced Magaldi supervisors.
Magaldi Industrie S.r.l. has been pleased to support its client not only as a systems supplier but also as a close and collaborative engineering partner.



Spain

Dependable hot rolled bar transportation in Seville

by **Antonello Marrazzo**, *Area Sales Manager* antonello.marrazzo@magaldi.com

The Spanish company Siderurgica Sevillana specialises in melting and hot rolling steel, as it has been doing since the mid 60s. Siderugica Sevillana is a member of the multinational RIVA Group, a leader in the steel sector and has a strong client relationship with Magaldi Industrie S.r.l.

At Siderurgica Sevilliana the existing steel coated conveyor was causing loss of production and excessive maintenance. The main problem of the existing conveyor was its very short life - never greater than 6 months. As the transported material is very sharp, if the material jammed the belt, the belt would be cut. When this happened the client was obliged to stop the production until the necessary repairs were made.

Siderurgica Sevillana solved its problems by selecting the Magaldi Superbelt® conveyor for the transportation of 400 °C hot rolled bars on the rolling line.

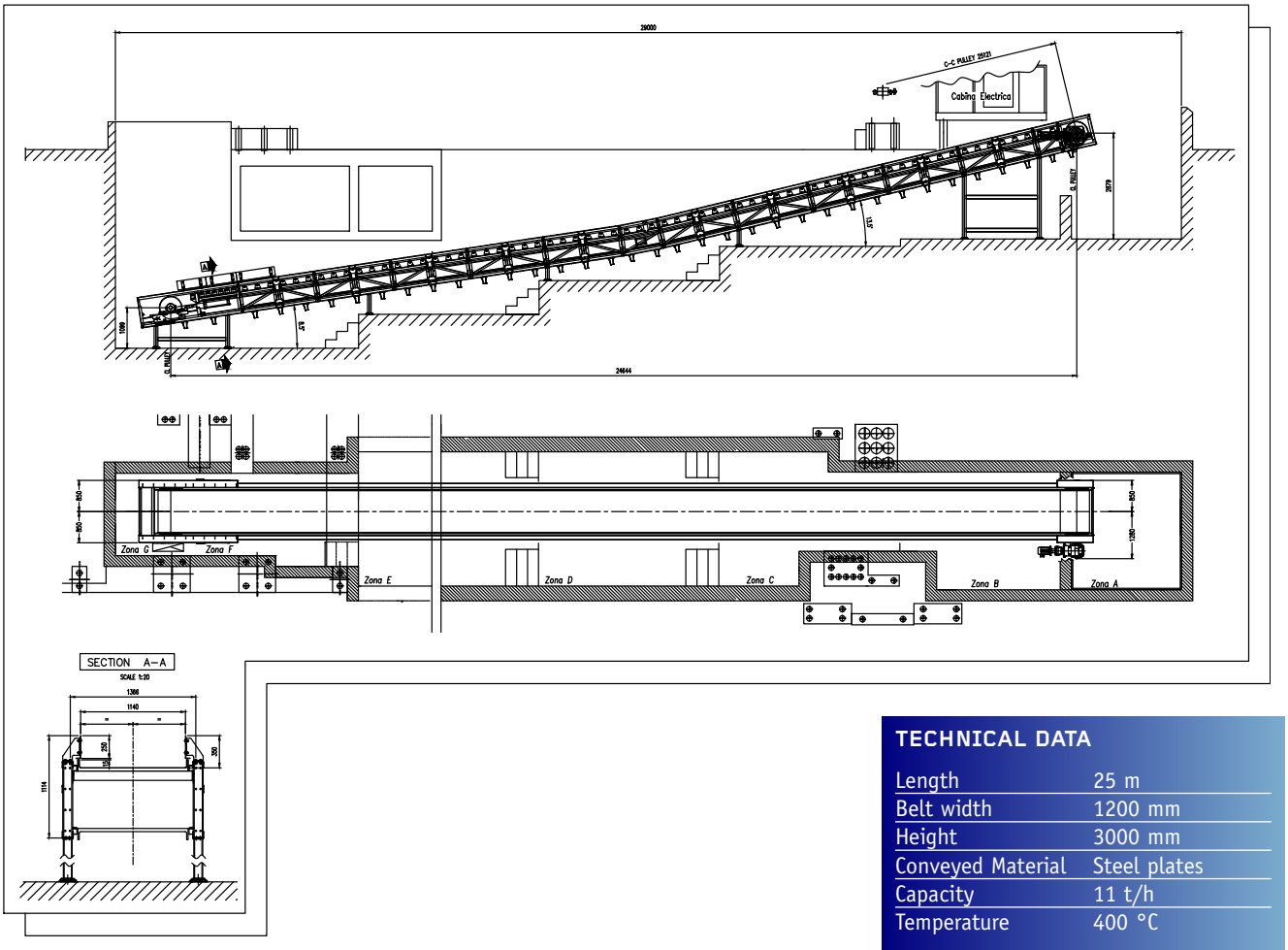
A Magaldi Superbelt® conveyor type PD/MN1208.108.S was installed in July 2013. It conveys bars at a rate of 11 t/h. The bars come from a rolling stand, through which the steel billet passes, reducing its section and acquiring the final product shape. The final sectors of the conveyor are inclined at 16° and in the loading area, special rollers have been installed: they are capable of withstanding the high impacts caused by material falling from the upstream conveyor which operates about 3 m above.

By connecting the conveyor pans directly onto the mesh of the belt, all elements are free to thermally expand without incurring any permanent deformations. As a result, the Magaldi Superbelt® is capable of withstanding temperatures higher than any other conveyor. Magaldi has guaranteed this belt for 3 years – its life expectancy however exceeds 10 years. This is Magaldi's superior patented technology.

"The Magaldi conveyor is working fine! I really hope that our next conveyor will be a Magaldi Superbelt®!", it is an example of appreciation from Siderurgica Sevilliana. Once again Magaldi has met and exceeded customer expectations.

PROBLEMS
- Loss of production
- Excessive maintenance
- Short life of the conveyor

BENEFITS
- High dependability
- Negligible maintenance
- Long life of the conveyor



TECHNICAL DATA

Length	25 m
Belt width	1200 mm
Height	3000 mm
Conveyed Material	Steel plates
Capacity	11 t/h
Temperature	400 °C

Mexico

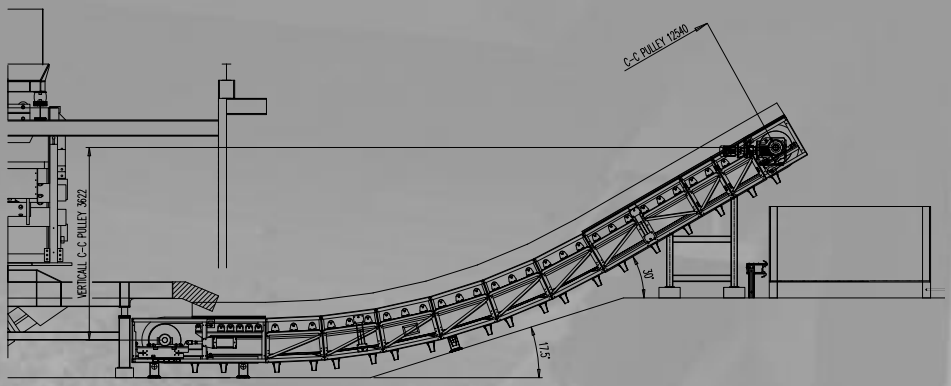
Runner breaker unloading at Tupy Ramos Arizpe

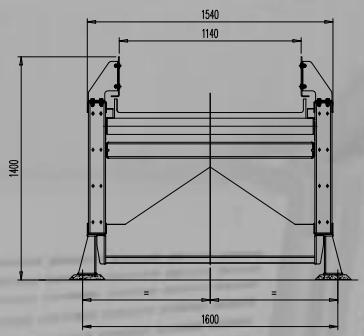
by **Antonello Marrazzo**, *Area Sales Manager*
antonello.marrazzo@magaldi.com

Downstream of the molding line, iron foundries can achieve greater efficiency by installing runner breakers which reduce the volume of material that is re-melted in the furnace. This can increase the density of re-melts and can eliminate bridging in the furnace, improving the furnace efficiency.
Installation of runner breakers may be an option in small foundries but it is in large foundries where the greatest efficiencies can be achieved. The runner breakers should be fed from dependable conveyors such as the Magaldi Superbelt®, the solution adopted by Tupy Ramos Aritpe (TRA) foundry in Mexico.
TRA was founded in 1938, in Joinville, Southern Brazil. Employing 12000, Tupy has an annual production capacity of 800000 tons of cast iron parts, exporting half of this annual production to more than 40 countries. Tupy Ramos Arizpe, Mexico, specializes in the production of engine blocks and heads and has a production capacity of 92000 tons per year.
TRA wanted to convey crushed material downstream of the breaker into a box located about 5 m above. A difficult task, because no vibrating conveyor was suitable to lift the materials within a distance of only 11 meters from the dis-

Crusher Loader.

charge of the breaker.
The Magaldi Superbelt® was the ideal solution, receiving the crushed material from the breaker upstream and loading it directly into the box. A Magaldi Superbelt® conveyor "P type" of about 12 m long and 1.2 m wide was installed in January 2014. The special design of the belt, with the plates partially overlapped, allows the conveyor to reach very steep inclinations without the conveyed material rolling back.
The Superbelt® "P type" conveyor is used for horizontal and inclined transportation (up to 35°) of heavy material, such as castings, sprues, forgings, scraps and crop ends. It is extremely robust, resistant to the shock loads generated by the falling of material, hammers, air cannons and/or manipulators during the sprue removal operation.
With this project, once again, Magaldi Industrie S.r.l. confirms its partnership with one of the most prestigious foundry in the world.





TECHNICAL DATA

Length	12.5 meters
Belt width	1200 mm
Height	3500 mm
Conveyed Material	Castings
Capacity	22 t/h
Temperature	50 °C

Magaldi Power and Millmerran Power Station win "Australian Bulk Handling - Environmental Project of the Year"

by **Anna Oxford**, *Magaldi Power PTY LTD* anna.oxford@magaldi.com
by **Michele Corrado**, *Magaldi Power S.p.A.* michele.corrado@magaldi.com

Magaldi Power in collaboration with Millmerran Power Station has been announced the 2013 winner of the Australian Bulk Handling "Environmental Project of the Year" building on its achievement in 2012 with the award for "Excellence in Conveying".

Located in South East Queensland, Australia, Millmerran Power Station is a two unit 850 MW coal fired power station, operational 24 hours per day, supplying electricity to over 1.1 million homes. Since operations began in 2002, Millmerran Power Partners (including InterGen) have made significant operational improvements that have resulted in it becoming one of the lowest cost electricity providers in Queensland and NSW. In achieving this, a series of environmentally sound principles have been integrated into its operations.

Until 2008, Millmerran Power Station managed ash removal with a Submerged Scraper Conveyor (SSC) system – a chain and sprocket conveyor. Ash was collected in a water filled hopper from where it was removed by the SSC and dumped on the ground, picked up with a loader and trucked to a holding area. It was then collected by mine trucks from the holding area and transported for disposal at the nearby mine site. This system of ash management created a dusty, dirty and unhealthy working environment and the numerous truck movements increased the hazards on site.

Not only were significant volumes of water also being consumed and treated to support this system but the SSC system was causing other problems. Millmerran Power Station had serious problems with bottom ash explosions – caused when large lumps of ash or clinkers fall into the cool water – again creating a dangerous environment for operators. Adding water to the ash was also increasing the weight and volume of the ash thereby increasing the costs of its transportation and removal.

As InterGen sought to improve safety, create better efficiencies, reduce costs and leave a smaller environmental footprint right across its operations, it was realized that significant improvements in bottom ash management and handling could contribute to the plant's overall performance.

During 2008/2009 Millmerran Power Partners engaged Magaldi Power to install two units of the Magaldi Ash Cooler (MAC®) with the aim of improving efficiency and creating a better working environment.

In 2013 Magaldi Power returned to Millmerran Power Station to assess how it had met the objectives of its client and how and if the MAC® was

Magaldi Ecobelt® at Millmerran Power Station.

delivering and performing to expectations. The results were extremely positive and included the following:

- A reduction in the cost of wet ash disposal
- Improved site safety because of dust elimination
- Reduced costs of waste bin cleaning
- Reduction in the plants water consumption – saving 210000 m^3 per year
- Savings by reducing the use of the auxiliary cooling system
- Improved boiler efficiency
- Elimination of dangerous bottom ash explosions
- Reduction in auxiliary load requirement
- MAC® system and benefits – well accepted by operating staff – fostering goodwill.

Arriving at 2013, Magaldi Power has not only been recognized for its superior technology but also for how its systems integrate and harmonize with the working and natural environment, creating safer and cleaner work places and improved efficiencies which have far reaching consequences for people, communities and the environment.

L to R
Mal Gamble, Chief Operations Manager InterGen
Anna Oxford, Magaldi Power PTY LTD
Peter Delbridge, Australian Bulk Handling.

Magaldi Power S.p.A. quality management system certified UNI EN ISO 9001:2008 since 2003

by **Marco Galasso**, *Quality Control Manager* marco.galasso@magaldi.com

The Company's quality policy has a common goal towards which the commitment of the whole organization converges. It has been developed around the following mission: "to offer advanced and competitive solutions, to design and realize industrial systems and components for bulk materials handling through solutions aimed at improving quality, optimizing resources and energy exploitation, and reducing environmental impact". Magaldi Power S.p.A. is constantly striving to improve its innovative products. The company is conscious that everything can be improved and understands that the company's future depends on its expertise in its fields.

Working in a global market and with the best available technology, it is important to pursue continuous improvement and surpass the expectations of clients who consider Magaldi Power S.p.A. as not just a supplier but also as a reliable partner.

For Magaldi Power S.p.A., the respect for the Environment, the Health and Safety of its employees, contractors, visitors and others who may be involved or may be affected by its activities, is an ongoing commitment and priority. With this in mind the company has developed:

1) an Environmental Management System complying with UNI EN ISO 14001:2004 soon to be certified;
2) a Safety Management System complying with OHSAS 18001 also soon to be certified.

In recent years the Magaldi Group has invested resources for the training and qualification of employees on work health and safety and to promote safe and environmentally friendly behaviors.

In relation to product quality control, the Magaldi Group has a specific department dedicated to quality

DNV BUSINESS ASSURANCE

MANAGEMENT SYSTEM CERTIFICATE

Certificato No. / Certificate No. ***CERT-12866-2003-AQ-NPL-SINCERT***

Si attesta che / This is to certify that

Il sistema di gestione per la qualità di / The quality management system of

MAGALDI POWER S.p.A.

Via Irno, 219 - 84135 Salerno (SA) - Italy

è conforme ai requisiti della norma:
has been found to conform to the standard:

UNI EN ISO 9001:2008 (ISO 9001:2008)
Valutato secondo le prescrizioni del Regolamento Tecnico RT-05
Evaluated according to the requirements of Technical Regulations RT-05

Questa Certificazione è valida per il seguente campo applicativo:
This Certificate is valid for the following product or service ranges:

Progettazione, supervisione alla costruzione, installazione di impianti "chiavi in mano"
Per: movimentazione solidi, estrazione e trattamento di ceneri pesanti da caldaie
alimentate a combustibile solido (Settore EA : 28 - 17 - 18)

Design, construction supervision, installation of "turn-key" systems for:
bulk material handling, extraction and treatment of heavy ash from
solid fuel fired boilers (Sector EA : 28 - 17 - 18)

La presente certificazione è intesa riferita agli aspetti gestionali dell'impresa nel suo complesso ed è utilizzabile ai fini della qualificazione delle imprese di costruzione ai sensi dell'articolo 40 della Legge No. 163 del 12 aprile 2006 e successive modificazioni e del D.P.R. 5 ottobre 2010 No. 207
This certificate is meant to refer to the general management aspects of the organization as a whole and may be used by construction companies for qualification purposes according to Art. 40 of the Law No. 163 dated 12 april 2006 and subsequent modifications as well as D.P.R. 5 October 2010 No. 207

Data Prima Emissione/Initial Certification Date:
2003-08-22

Il Certificato è valido fino al:
This Certificate is valid until:
2015-07-29

L'audit è stato eseguito sotto la supervisione di/
The audit has been performed under the supervision of

Luigi Fausto De Giovanni
Lead Auditor

Luogo e Data/Place and Date:
Agrate Brianza (MB), 2012-07-23

Per l'Organismo di Certificazione:
For the Accredited Unit:

Zeno Beltrami
Management Representative

La validità del presente Certificato è subordinata al rispetto delle condizioni contenute nel Contratto di Certificazione.
Lack of fulfilment of conditions as set out in the Certification Agreement may render this Certificate invalid.

DET NORSKE VERITAS ITALIA SRL - CENTRO DIREZIONALE COLLEONI - PALAZZO SIRIO - V.LE COLLEONI, 9 - 20864 AGRATE BRIANZA (MB) - ITALY - TEL. 039 68 99 905 - WWW.DNVBA.COM/IT

"For a project in Russia, Magaldi Power S.p.A was the supplier for the MAC conveyor system and a scope of several related components like structures, crushers and a silo. I was impressed by the overall excellent quality I found at the Magaldi workshop. Also the documentation and the close supervision of sub-suppliers met all requirements and are a proof of the efficient quality policy, which is realized at Magaldi."

M. Lange, Quality Inspector, T.CIN Technology GmbH / Germany

and compliance with customer specifications.
Magaldi Quality Control department is composed of internal staff with qualifications to perform all the checks required by international standards during the phases of materials acceptance, manufacturing, assembly, shipping and site installation. We have dedicated resources responsible for checking all materials accepted into our Buccino factory, during the internal manufacturing phases at the Buccino factory and before shipment and for checking materials at the suppliers' factories and at customers' sites. A dedicated Manager coordinates all check activities.
At the beginning of all projects, a specific Quality Control Plan is defined. It contains a list of all the items that are part of the scope of supply and, for each of item it describes all the checks that must be performed. These checks are referenced against standards for the execution, acceptability criteria and the required reporting to be provided for each control, all in accordance with the customer's technical specifications.
When specifically requested by our customers or when it is necessary because the product does not have standard characteristics, we also include in the Quality Control Plan functional tests on equipment partially pre-assembled in the Buccino factory.
Among the various checks carried out in the construction phase, particular importance is given to the special processes of welding and painting.
Magaldi Group uses only qualified welders. Welding procedures are qualified and the quality control staff has all the qualifications to perform all non-destructive testing on welds, which are performed in a programmed way on all welded components.
In relation to painting, both staff working in the production area and control staff are periodically trained on the proper use of products, the correct painting techniques and the type of checks to be carried out before, during and after paint application.
Magaldi Group is equipped with all the necessary devices to perform Quality controls. The devices are certified and periodically calibrated to ensure perfect functionality. A dedicated employee takes care of all measuring devices, including storage. Expiry dates are monitored and accurate records are kept of who and when the devices are used. Any non-conformities found during the checks are recorded and managed through a software program that monitors the non-conformity from its initial identification to resolution. The history of non-conformities is used to analyze the causes of non-compliance and to implement preventive actions to avoid risks of repeated problems.
Over the years, working for major international companies, in Europe, America, Australia, South Korea and Japan the Magaldi Group has had experience with a wide range of methodologies and technical specifications as required by the clients. This has allowed the company to draw on the very best of these expertise and use them to build on and develop its own high standard of methodology, procedure and practice.

MAGALDI®
Dependable technologies

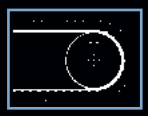
MAC® – Magaldi Ash Cooler
Dry bottom ash extraction system

SUPERMAC®
Extraction and air/water cooling system
for large quantities of heavy ashes

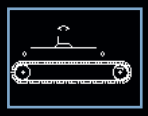
Magaldi FLUIMAC®
Dry ash extraction system for fluid bed boilers

MAGALDI MRS® – Magaldi Mill Rejects System
Dry coal mill rejects handling system

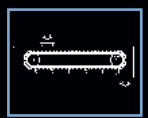
MAR® – Magaldi Ash Recycling
Dry extraction and recycling of bottom and fly ash



Magaldi Superbelt® (E/N/P/PR/PRZ/HD)
Dependable steel belt conveyor



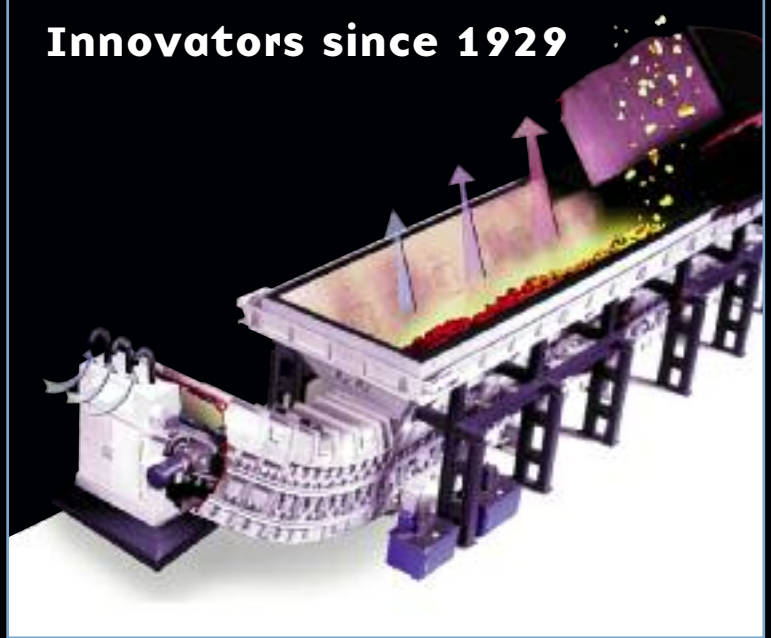
MCC® – Magaldi Casting Cooler
Magaldi Superbelt for forced air casting cooling



Magaldi Ecobelt®
Enclosed self cleaning Superbelt conveyor

Magaldi Ecobelt® WA
Dry ash extraction for waste ash

Innovators since 1929



Magaldi Group:

Registred office:
26, Piazza di Pietra - 00186 ROMA, Italy
Head office:
219, Via Irno - 84135 SALERNO, Italy
ph. +39 089 688 111 - fax +39 089 481 766
ph. +39 089 489 111 - fax +39 089 274 431
e-mail: federica.pinto@magaldi.com

Australia General Licensee
Magaldi Power Pty Ltd
5/600 Pacific Highway
2280 Belmont NSW
ph. +61 2 49450755
fax +61 2 49479749
e-mail: anna.oxford@magaldi.com

Germany General Licensee
Magaldi Power GmbH
Boschstr. 10
73734 Esslingen, Germany
ph. +49 711 93150 340
fax +49 711 93150 345
e-mail: guenter.baur@magaldi.com

India General Licensee
Magaldi Power India Pvt Ltd
Flat 8, 4th Floor, 147 Lake Gardens
700 045 Kolkata
ph. +919830808228 / +919434748228
e-mail: debasish.chakraberty@magaldi.com

Japan - Power Plant Domestic Market Licensee
Kawasaki Heavy Industries, Ltd.
1-14-5, Kaigan, Minato-ku, Tokyo
105-8315, Japan
ph. +81-3-3435-6748
fax +81-3-3435-6601
e-mail: takahashi_shige@khi.co.jp

www.magaldi.com

designed by **Valeria Forte** *printed by* **Grafica Martino, Buccino_14**