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PRESIDENT MESSAGE

Census of the world casting reported that in the year 2016 production was 104.4 million metric tons and grew by less than half percent for the second time according to their report published in Modern Casting magazine USA and casting growth is 0.2% over 2015.The China Foundry Association reported 5.4% increase since 2015 contributing 45% of total worldwide casting production. The institute of Indian Foundrymen reported a 5.4% increase (as in China) increase in production in India to 11.35 million metric tons.

As the world is witnessing China and India's growth, Pakistani foundries are beginning to benefit by the growth opportunities offered by CPEC. It is hearting to see that small and medium enterprises are beginning to understand the global requirements of producing castings by improving technology and skills of human resource.

To support the industry and specially small and medium enterprises, Pakistan Foundry Association has signed MOU's with China Foundry Association and Tianjin Foundry Association for the training of man power in new foundry skills and technologies.

With the growing demand of skilled manpower by the foundries in private sector, Foundry Service Center will play its pivotal role. Pakistan Foundry Association (PFA) and University of Engineering & Technology Lahore-Pakistan (UET) have joined hands to develop human resource in modern foundry skills and technologies at Foundry Service Center (FSC).We look forward to Infinity school of engineering forextending support and cooperation in the training of master trainers and lab technicians in coordination with UET.

I encourage all our members and friends from various industries to visit Foundry Service Center and benefit from the laboratory services beside registering their workers and staff in training courses on Cad Designing, Casting Process Simulation Software, CNC Programing, Material testing and Evaluation, and Molding and Casting Shop Floor Skills. Participation of the local foundry industry will not only reduce thisventurea successbut they will also benefit in improving skilled manpower.

My compliment to the EC members who have taken the initiative of fostering relations with the Chinese Foundry Industry to collaborate with our Foundries.

Sikandar Mustafa Khan
President - PFA

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Global Casting Production Growth Stalls

Worldwide casting production grew by less than half a percent for the second year in a row in 2016. **A MODERN CASTING STAFF REPORT**

Courtesy :Modern Casting- USA

In 2016, worldwide casting production was 104.4 million metric tons, a near match to 2015s reported 104.1 million metric tons, according to this years *Modern Casting* Census of World Casting Production. Casting growth from 2014 to 2015 was 0.4%, and from 2015-2016, it was 0.2%.

This years census includes 36 nations from four continents. Of the 32 countries with data for the last two years, 14 reported an uptick in production. The information in this census comes from surveys collected from various countrys metalcasting associations and organizations. The data reflects casting shipments for the year 2016, the latest year in which all data is available.

The worlds top 10 casting produc - ing nations produced 91.6 million metric tons of the total 104.4 million metric tons.

The China Foundry Association reported a 5.4% increase since 2015, putting its total production at 47.2 million metric tons45% of total world casting production. The Institute of Indian Foundrymen reported a 5.4% increase in production in India, to 11.35 million metric tons, gaining space ahead of the U.S., which has seen lower tonnage shipped in 2015 and 2016 compared to 2014 due to flagging production for iron-heavy industries such as agriculture, oil and mining. The U.S. is expecting growth of 2.8% in tonnage and 4.7% in casting sales in 2018.

The remaining 2016 top 10 casting nations by tonnage are Japan at 5.2 million, Germany at 5.2 million, Russia at 3.9 million, Republic of Korea at 2.6 million, Mexico at 2.56 million (2015 data), Brazil at 2.1 million, and Italy at 2.1 million.

Worldwide, the production of ferrous castings, including gray iron, ductile iron, malleable iron, and steel, was down by 1%. Considering ferrous casting makes up nearly 80% of total tonnage, the impact of was felt by many nations. However, nonferrous production grew by 5.7%, highlighting the continued trend of using lighter metals in what had been typically ferrous applications. MC

World Totals (metric tons)

Gray Iron	Ductile Iron	Malleable Iron	Steel	Copper Base	Aluminum	Magnesium	Zinc	Other Nonferrous	Total
46,241,871	25,467,378	817,620	10,652,260	1,872,213	17,876,299	317,578	1,005,656	128,056	104,378,931

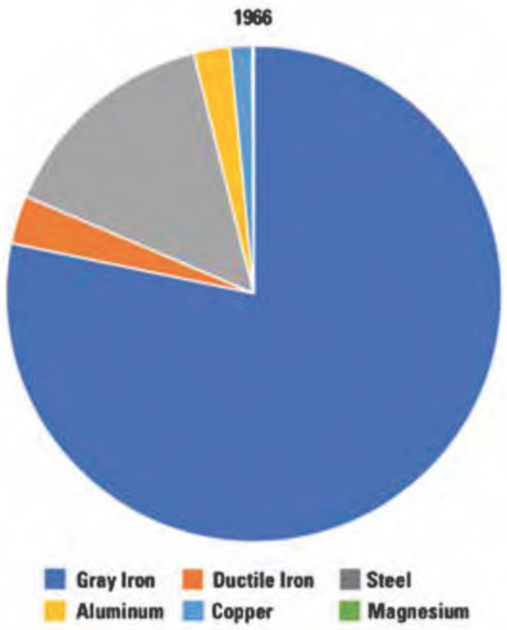
Individual Countries (metric tons)

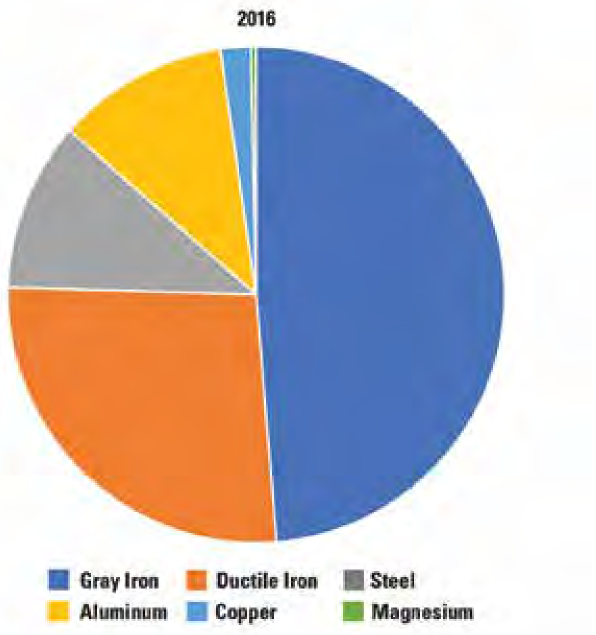
Country	Gray Iron	Ductile Iron	Malleable Iron	Steel	Copper Base	Aluminum	Magnesium	Zinc	Other Nonferrous	Total
Austria	42,362	101,770	-	11,284	-	140,840	6,256	-	12,347	314,859
Belgium	26,900	7,200	-	17,400	-	783	-	-	-	52,283
Bosnia & Herzegovina	17,500	9,100	-	1,350	-	10,500	-	-	-	38,450
Brazil	1,257,825	515,875	-	164,200	21,900	136,000	5,800	1,400	-	2,103,000
Canada**	330,841	-	-	90,091	14237	216189	-	-	-	651,358
China	20,350,000	13,200,000	600,000	5,100,000	800,000	6,900,000	-	250,000	-	47,200,000
Croatia	31,100	11,800	-	50	221	25,174	-	25	15	68,385
Czech Republic	158,000	51,800	-	61,000	20,000	98,000	-	1,000		389,800
Denmark	20,400	52,500	-	-	779	3,117	-	-	128	76,924
Finland	15,300	33,500	-	8,400	2,630	2,114	-	86	-	62,030
France	531,500	675,200	-	57,000	17,724	324,102	-	20,329	2,340	1,628,195
Germany	2,234,900	1,509,900	-	174,200	78,471	1,096,707	17,398	56,247	1	5,167,824
Hungary	21,700	57,900		3,800	1,681	118,246	391	2,985	123	206,826
India	7890000	1,180,000	50,000	1,010,000	-	1,220,000	-	-	-	11,350,000
Italy	714,200	381,200	-	57,000	66,081	782,691	7,384	70,474	654	2,079,684
Japan	2,224,000+	1,301,300	41,000	150,100	77,400	1,380,570	-	23,530	5,400	5,203,300
Korea	1,073,500	707,800	3,000	163,100	26,300	623,200	13,100	-	-	2,610,000
Mexico**	815,500	375,800	-	330,790	217,200	735,300	-	85,600	-	2,560,190
Norway	10,900	19,200	-	-	-	6,373	-	-	-	36,473
Pakistan	142,000	24,540	-	42,600	12,400	16,300	-	-	2,200	240,040
Poland	484,000	166,200	-	50,500	6,100	331,500	-	7,600	2,900	1,048,800
Portugal	39,400	93,400	-	7,800	16,000	32,400	-	-	-	189,000
Romania	20,565	4,306	505	6,893	3,590	82,057	5,000	115	137	123,168
Russia	2,000,000	380,000	20,000	800,000	100,000	450,000	100,000	50,000	-	3,900,000
Serbia	26,368	8,220	-	12,125	2,010	10,120	1	42	-	58,886
Slovenia	74,235	30,986	3,100	31,344	947	47,584	26	3,494	65	191,781
South Africa	145,000	163,200++	-	85,000	7,000	24,000	-	500	-	424,700
Spain	379,900	671,400	-	65,600	15,098	138,591	-	9,079	706	1,280,374
Sweden	159,600	49,500	-	21,215	6,934	43,089	1,482	8,531		290,351
Switzerland	35,400	22,800	-	1,100	2,308	12,902	-	989	-	75,499
Taiwan	510,425	187,711	-	66,028	32,662	303,020	-	-	-	1,099,846
Thailand***	72,400	28,800	29,500	29,800	26,100	105,400	-	24,400	-	316,400
Turkey	650,000	655,000	-	166,000	22,500	370,000	-	35,000	-	1,898,500
Ukraine**	400,000	120,000	30,000	580,000	60,000	280,000	15,000	25,000	50,000	1,560,000
U.K.	125,800	178,500	-	40,700	8,500	123,200	3,000	7,000	-	486,700
U.S. Metric	3,210,350	2,490,970	40,515	1,245,790	205,440	1,686,230	142,740	322,230	51,040	9,395,305

* 2014 Results ** 2015 Results ***2013 Results +Includes cast iron pipe ++Includes white iron

ALLOY TRENDS OF A HALF CENTURY

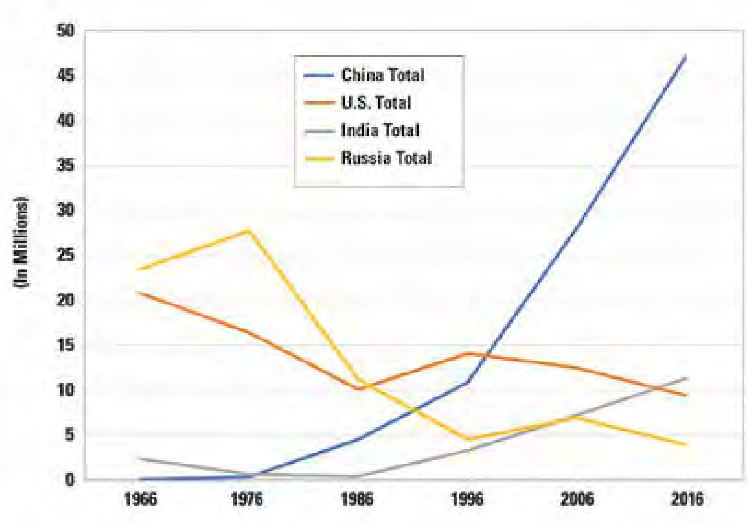
The picture of alloy production has changed much in the last 50 years. As shown in the pie graphs below, gray iron (blue), while still the highest produced alloy (by tonnage) has decreased from over three-quarters of the pie to less than half. Meanwhile, ductile iron (orange) and aluminum (yellow) has grown considerably.

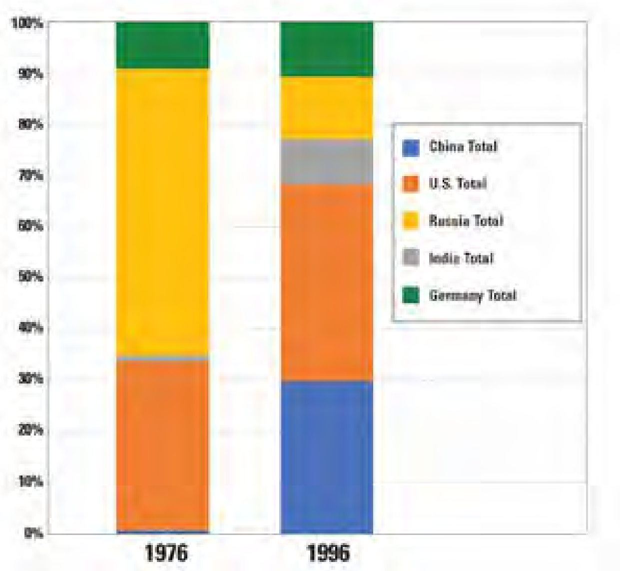




SHIFTS IN CASTING CONCENTRATIONS

With more than 50 years of worldwide casting production data now accumulated through *Modern Casting*s Census of Casting Production, comparing how casting production has expanded and shifted across the globe is illuminating. Below, we share how casting production has changed for a handful of historically major casting producing nations for which we had data. In the line chart, China and Indias 10-year trends are compared to U.S. and Russia during the past 50 years. The bar chart on the right reflects the 20-year time period when both China and Indias production shifted from a negligible to a considerable stake.





Metalcasting Plants by Nation & Trends

Country	Iron	Steel	Nonferrous	2016 Total
Austria	20	3	35	58
Belgium	10	5	6	21
Bosnia & Herzegovina	5	2	4	11
Brazil	408	153	484	1,045
Canada*				175
China	14,000	4,000	8,000	26,000
Croatia	26	5		31
Czech Republic	71		37	108
Denmark	8		7	15
Finland	11	7	13	31
France	86	34	291	411
Germany	195	46	340	581
Hungary	28	9	87	124
India				4,600
Italy	140	37	878	1,055
Japan**				1,612
Korea	523	141	235	899
Mexico**				681
Norway	6	3	6	15
Pakistan	1,580	55	170	1,805
Poland	185	36	240	461
Portugal	23	8	57	88
Romania	35	20	50	105
Russia				1,140
Serbia	11	8	17	36
Slovenia				46
South Africa		79	86	165
Spain	45	29	52	126
Sweden	27	12	59	98
Switzerland	15	2	30	47
Taiwan				-
Thailand*	280	40	260	580
Turkey	439	105	383	927
Ukraine	270	280	290	840
U.K.	216		204	420
U.S.	625	349	987	1,961
TOTAL	**19,288**	**5,468**	**14,494**	**46,318**

*2014 Results **2015 Results

WORLD CASTING PRODUCTION PER PLANT

The number of metalcasting facilities in the world declined in 2016, following a trend of the last decade of fewer metalcasting facilities making an increasing tonnage of castings. Casting businesses worldwide are consolidating and becoming more efficient. Germany continues to be the highest casting producer per plant, with an average of 8,895 metric tons annually. The U.S. averaged 4,791 metric tons per plant in 2016.

-1.4%

The total reduction of metalcasting facilities worldwide from 2016 to 2015.

2,216

Average world casting production per plant in 2015 in metric tons.

2,253

Average world casting production per plant in 2016 in metric tons.

FEIN. Unverwüstliche Elektrowerkzeuge.

The story of FEIN is the story of the invention of power tools.

In 1867, Wilhelm Emil Fein founded a company to manufacture physical and electrical equipment where his son Emil Fein invented the first electric hand drill almost 30 years later in 1895. This invention paved the way for highly reliable power tools, which FEIN still manufactures at its site in Germany and for which the long-standing German company is known in industry and manual trades throughout the world to this day. FEIN has been a world-leading power tool manufacturer for over 150 years and without a doubt one of the main reasons for this is that FEIN continues to meet its own standard of only developing durable power tools with every new product innovation it creates today.

Fein Middle East FZE, located in Jebel Ali Free zone, Dubai is the subsidiary of C. & E. Fein GmbH – and has been in operation since 2011 providing technical and commercial support to customers in the MENA region. The facility also contains a training centre equipped with the latest FEIN range of machines.

FEIN is the specialist for professional and extremely reliable power tools and special application solutions in the metal, interior and automotive sectors.

FEIN market segments

METAL

- ✓ Stainless steel machining
- ✓ Heavy-duty grinding
- ✓ Metal drilling and core drilling
- ✓ Metal construction
- ✓ Pipe processing

INTERIOR

- ✓ Drywall construction
- ✓ Surface processing of wood
- ✓ Assembly of wood
- ✓ Fitting on roofs and façades
- ✓ Interior work and renovation

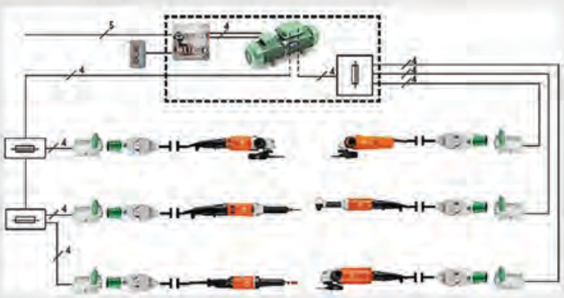
AUTOMOTIVE

- ✓ Glass removal for vehicles
- ✓ Special vehicle construction
- ✓ Vehicle repairs
- ✓ Industrial volume assembly
- ✓ Boat maintenance

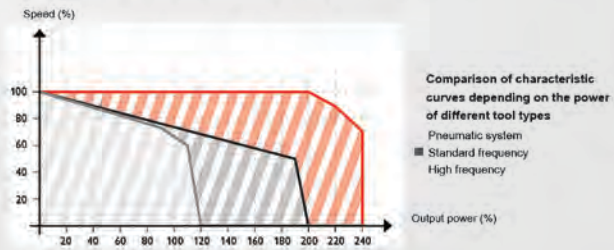
FEIN high frequencey – a real boost to industrial production

In electrical engineering, frequencies above 10 kHz are described as high-frequency. But for power tools this term is commonly used to describe all frequencies above the standard mains frequency of 50/60 Hz. Modern high-frequency power tools usually operate at a frequency of 300 Hz. Please see the following diagram as a complete system with converter from 50/60 Hz to 300 Hz.

Stationary high-frequency systems

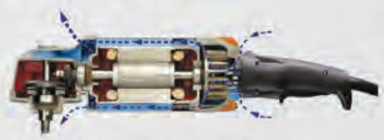


Higher frequency, constant speeds, higher performance. The superior tool concept of FEIN high-frequency power tools makes them particularly well suited to use in metalwork, for heavy-duty grinding and continuous use when roughing-down or cutting under the toughest working conditions.



Save with High frequency

In terms of investment, energy and maintenance costs, High-frequency power tools are much more cost-effective than comparable standard frequency or pneumatic tools. They also enable greater grinding efficiency. The encapsulated design of the tools prevents dust from entering the rotating parts. The tools are cooled on the surface of the motor. The metal gear head withstands very high loads.



FEIN benefits

Once installed and started up, system:

- ✓ Requires virtually no maintenance
- ✓ No special structural work is needed to install the frequency converter
- ✓ Low voltage peaks, distortion factor
- ✓ All components designed for maximum load capacity in industrial use
- ✓ Maximum tool output when operating with a stationary system.
- ✓ Prevents the power tools used from being thermally overloaded and therefore extends the service life

FEIN high frequency benefits

Compared with standard frequency:

- ✓ 50% less grinding disc consumption
- ✓ labour costs for a defined job (increased material removal = greater productivity)
- ✓ 75% lower maintenance costs
- ✓ 32% lower overall costs

The cost of purchasing a FEIN high frequency tool with single-station converter will be paid off in just one year.

FEIN high frequency benefits

Compared with pneumatic system:

- ✓ 90% lower energy costs
- ✓ 70% lower investment costs
- ✓ 75% lower maintenance costs
- ✓ 50% less grinding disc consumption
- ✓ 10% more material removal, i.e. greater work productivity

Investing in a high-frequency system from FEIN will pay off very quickly.

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Hand Moulding - Quality and Environmental Advantages Thanks to Low-Sulphur Binder System

Norbett Benz
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Email:cfourberg@huettenes-albertus.com

Converting to a new binder system for mould and core production is a real challenge for any foundry. It involves a substantial change to an existing process and is only done with the promise of clear benefits. With the aim of expanding its position in the supply of highly-specialised castings, the Dorsten-based metal and iron foundry, Franz Kleinken GmbH, took up this challenge. In co-operation with the foundry chemicals company Hüttenes-Albertus, Kleinken launched a low-sulphur furan resin binder system, which delivers both quality and environmental gains.Sabine Umla-Latz of Hüttenes-Albertus reports on the project.

Kleinken produces highly-specialised cast parts for almost every industry sector. The portfolio ranges from precision parts for gas and steam turbines or pumps, to components for power plant construction and the food industry. Specialties also include thermally resistant components, which are used in high temperature applications of 200-600 C. All foundry products can be completely finished in-house, providing customers with ready-made products from a single source.

Since 1921, Kleinken has continually developed its casting expertise. Today, the company, with 140 employees, produces and processes around 4,000 tonnes of castings, often for customers from all over the world who come to get exactly the 'custom cast' required for their high-quality end products. Their cast parts made of grey, SG and vermicular cast iron weigh up to 30 tonnes, while meeting the strictest quality criteria.

For their high-precision, high-quality castings, customers are increasingly demanding compliance with the ASTM-A standards. These standards set by the American Society for Testing and Materials include special methods for testing mechanical properties and surface finish, which must meet the highest requirements. For example, ultrasound is used to check the basic structure (matrix) for cavities or inclusions. Surface quality is assessed by magnetic particle inspection or dye penetrant testing.

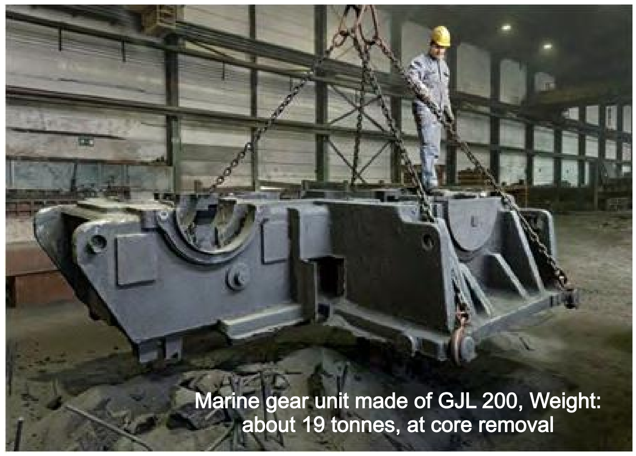
Joint development of solutions

To enable reliable production of up to 20,000kg cast parts for the premium segment of SG iron, the Kleinken metalwork plant planned to switch to a new binder system for mould and core production.

The experts from Kleinken and Hüttenes-Albertus worked closely together to develop a solution. An analysis of the current process and the used sand levels in the foundry was followed by extensive testing in the HA laboratory, during which the bending strength of the moulding material was determined and compared. Due to the persuasive results, the changeover to the new binder system took place very quickly.

Kleinken is a pure manual moulding foundry - it does not produce large-series runs, rather sticking to customised cast parts or small batches on customer order. Moulds and cores for castings, which are often difficult to model, are manufactured and assembled exclusively by skilled craftsmen - mostly in-house built. As a result of the cast part size and the customised production process, Kleinken has opted for a cold-curing process, also called no-bake process, during mould and core production. Core production processes involving gas or heat curing are not suitable for large and thick-walled castings for technical reasons.

In the no-bake process, the moulding base material is mixed in flow mixers with a binder and an acid, which acts as a catalyst or hardener.



Marine gear unit made of GJL 200, Weight: about 19 tonnes, at core removal

Guide vane housing made of GJS 400, Weight: seven tonnes

Hüttenes-Albertus, a leading producer of foundry resin binders, has, for decades, been offering cold-curing systems for mould and core production for large-scale and single cast parts. These products have been and will continue to be developed to meet the growing demands of foundries and their customers.

Modified furan resin helps to reduce sulphur content in hardeners

The binder system chosen by Kleinken is a modified, extremely reactive, furan resin in combination with an acid that requires less sulphur due to the binder's high reactivity. The furfuryl alcohol, as an essential component of the furan resin, reacts with itself during acid catalysis, polymerises and hardens. Special ingredients make the resin particularly reactive, which allows a reduction in the sulphur content in the acid catalyst.

One of the disadvantages of an increased sulphur content is a potential reaction of the melt with the mould material. This leads to the formation of extensive pockmark-like roughening and recesses on the casting surface. This 'orange peel' texture is often covered with a white-bluish film layer, which consists of fibrous SiO2. SG cast iron is most prone to this defect.

Fig.1 Highest surface quality: In this cross-member for a pressing machine made of GJS 400-18, the entire surface (100 per cent) undergoes magnetic particle inspection

Fig.2 Specialist work: complex core assembly for the cast part of a machine tool

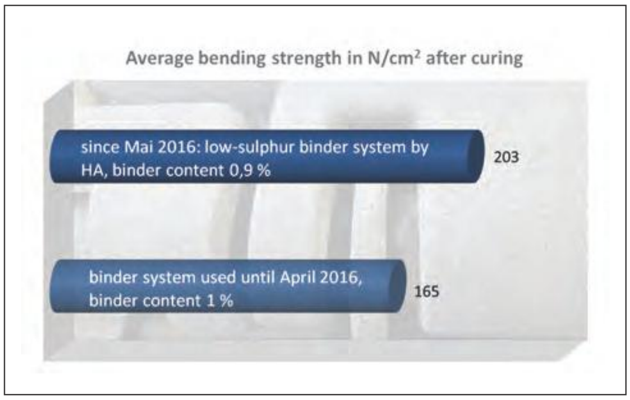


Fig.3 Higher tensile strength with less added binder

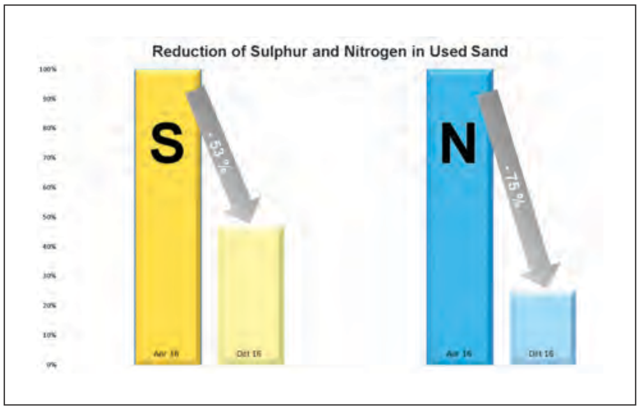


Fig.4 Less sulphur and nitrogen in used sand

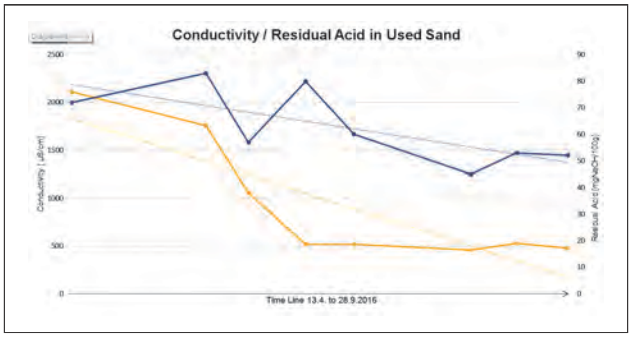


Fig.5 Less conductivity and residual acid

Fig.6 Frank Weber, foundry manager, presents the core of a boiler

It occurs predominantly in thick-walled parts, i.e. in medium to heavy, but also in very compact cast part. The areas most strongly affected are the ones where the metal remains liquid for long periods of time and is therefore exposed to long reaction times and a high heating of the moulding material. In the area of the rim zone, graphite degeneration may also occur.

Surfaces clearly enhanced

The low-sulphur HA furan resin system (consisting of cold resin series 8500 and series 7901, 7674 and 7809 activators), which is now used by the Kleinken foundry, provides significantly improved surfaces. At the same time, important parameters such as the processing time of the moulding material and the curing time have been optimally set.

The newly introduced binder system also has a positive economic aspect - resin addition could be reduced from one to 0.9 per cent, while at the same time increasing the strength of moulds and cores (see fig.3). The lowered addition of binder goes hand in hand with a reduction in emissions during casting. This has benefits for both the working environment and the natural environment. In addition, another effect has been observed; due to the reduced amount of binder, the moulding material is more flowable and can be better compacted. Gas defects or mineralisation occur less frequently.

As shown in fig.4, sulphur (S) and nitrogen (N), known as interfering elements in recycled furan resin sand, could be significantly reduced over the period from April to October 2016 (i.e. the six months during changeover). This can be explained by the system change as well as by the savings in the quantity added.

Fig.5 (conductivity and residual acid) confirms the immediate trend that the 'mild' activators progressively reduce the salt load on the sand grain surface and thus reduce conductivity. The acidic components, as expressed by the value of residual acid, could also be continuously reduced.

Environmental and cost benefits - less new sand required

The topic of used sand plays an important role in environmental compatibility. Moulding materials solidified with furan no-bake binders is very well suited for recycling and can be reused several times for the production of moulds and cores. However, care must be taken to ensure that the sulphur content, which accumulates over time in the moulding material, does not exceed a fixed threshold. If it does so, then some has to be replaced by new sand. With a low-sulphur binder system, this accumulation takes place more slowly; the recycled sand can remain in circulation longer and the addition of new sand can be reduced. Comparative analyses show that the sulphur content in recycled sand has almost been halved with the new binder system. This protects the environment and helps reduce landfill costs.

"The new system, which we introduced in co-operation with Hüttenes-Albertus, offers a high level of process reliability", reports Frank Weber, foundry manager. "This means that we are able to meet the high requirements of our customers more easily in the segment of particularly high quality castings while achieving better process control. At the same time, we are seeing positive economic and environmental effects, which bring us important advantages as a foundry."

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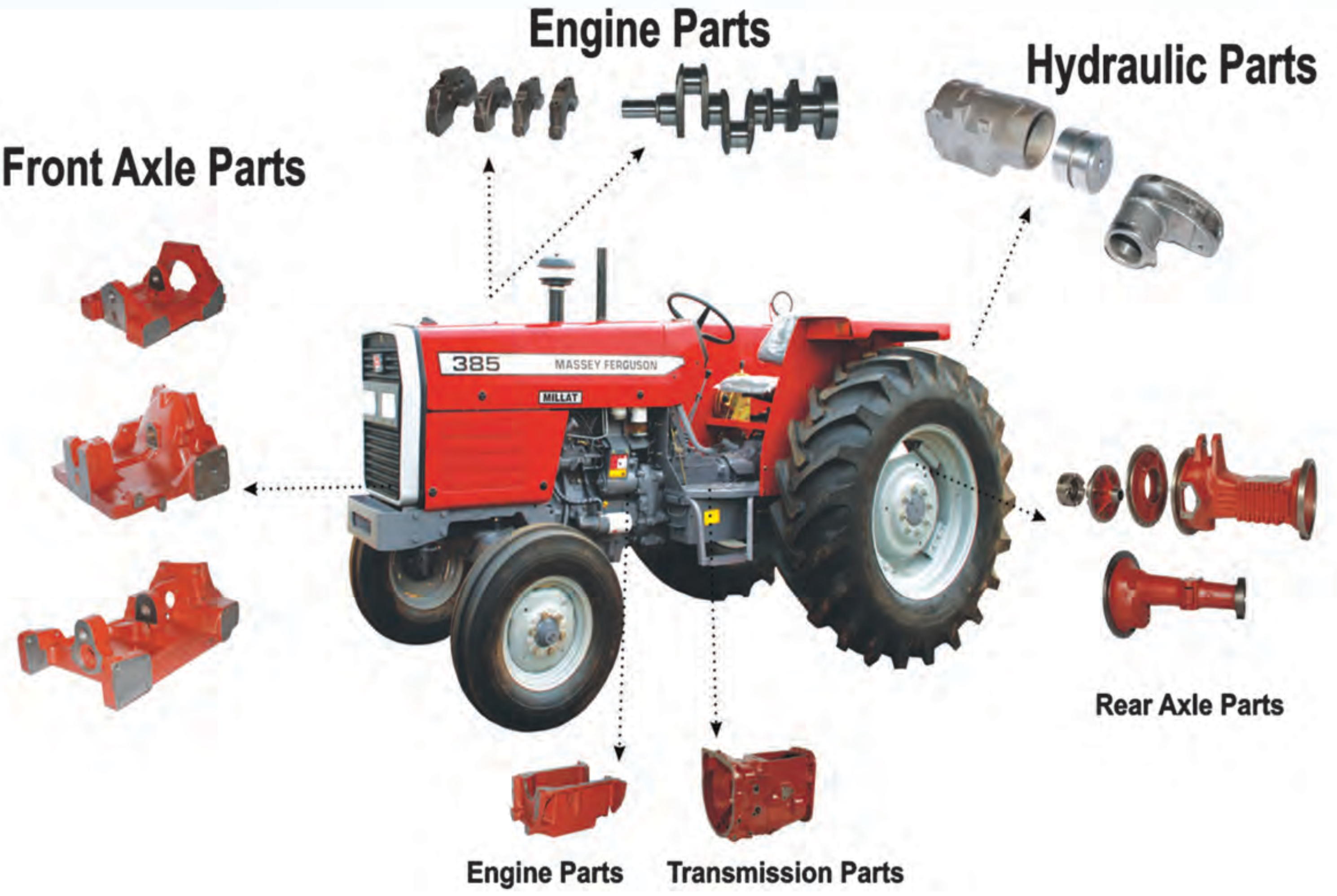

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Foundry Service Center (FSC) Rehabilitation
by
PFA & UET, Lahore.

Abdul Rashid, Secretary-PFA

Foundry Service Center (FSC), Lahore was a joint project of SMEDA, PFA and UET designed to provide various facilities/services like virtual casting, design and pattern making, prototype development, testing and consultancy to foundrymen. The funds for the project had been approved by Government of Pakistan and subsequently the project implementation have been initiated. PFA support and valuable inputs during the entire process of proposal development were of significant value.

Foundry Service Center was made operational in the year 2015 and provided services to the Foundry industry of Pakistan for a certain time. Unfortunately it was closed down due to insufficient income generation to be self-sufficient. Although Mr. Sikandar Mustafa Khan, President-PFA did his best to keep it running by providing services and had many meetings with SMEDA officials in this regard but no progress made to keep it running.

Foundry Service Center was handed over to University of engineering and technology few months back and by the keen interest of Dr. Fazal Ahmed Khalid, VC-UET and Mr. Sikandar Mustafa Khan, President-PFA certain measures have been taken to restart its facilities for the Foundry Industry.

With the growing demand of skilled manpower by the foundries in private sector, Foundry Service Center will play its pivotal role. Pakistan Foundry Association (PFA) and University of Engineering & Technology Lahore-Pakistan (UET) have joined hands in a meeting and decided to restart FSC for human resource development in modern foundry skills and technologies at Foundry Service Center (FSC).

To restart FSC following training courses has been selected….

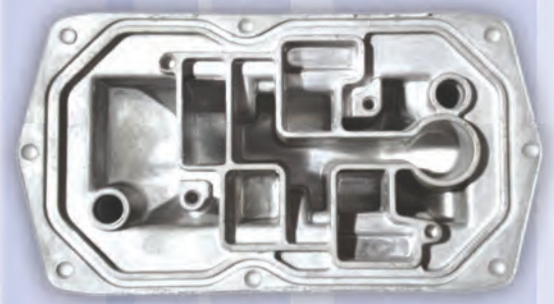
“ Following training courses are proposed to restart; for which partial funding will be made available from Pakistan Skill Development Fund (PSDF), Technical Education & Vocational Training Authority (TEVTA)& National Vocational & Technical Training Commission (NAVTTC)……..

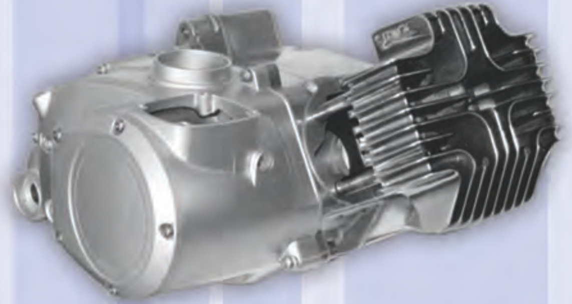
i. CAD Design
ii. Training on Casting Process Simulation Using Software "NOVA”
iii. CNC Programming for Digital Pattern Making
iv. Material Testing & Evaluation
v. Molding & Casting Shop Floor Skills

" Foundry Service Center (FSC) will be made operational by February, 2018 to reinstate trainings and services to the foundry members of the Pakistan Foundry Association (PFA)in specific and foundry industry in Pakistan at large.

" The management of Foundry Service Center (FSC) will be overseen by Mr. Asim Qadri, Secretary General of Pakistan Foundry Association (PFA) and Dr. Furqan Ahmed, Associate Professor- UET with the overall consensuses of Foundry Service Center (FSC)Board of Management (BOM).

" Infinity School Engineering will extend all possible cooperation in training of master trainers and lab technicians in coordination with UET.





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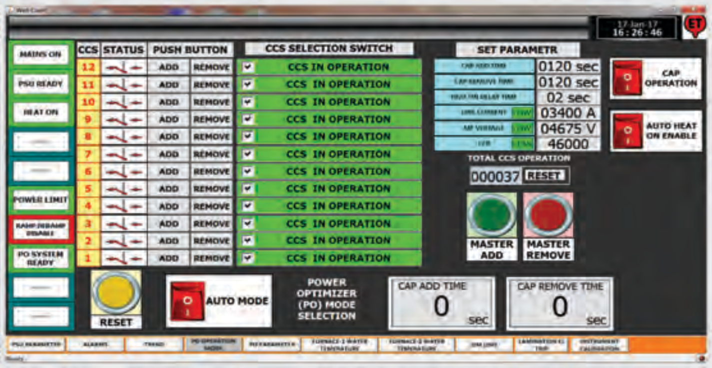

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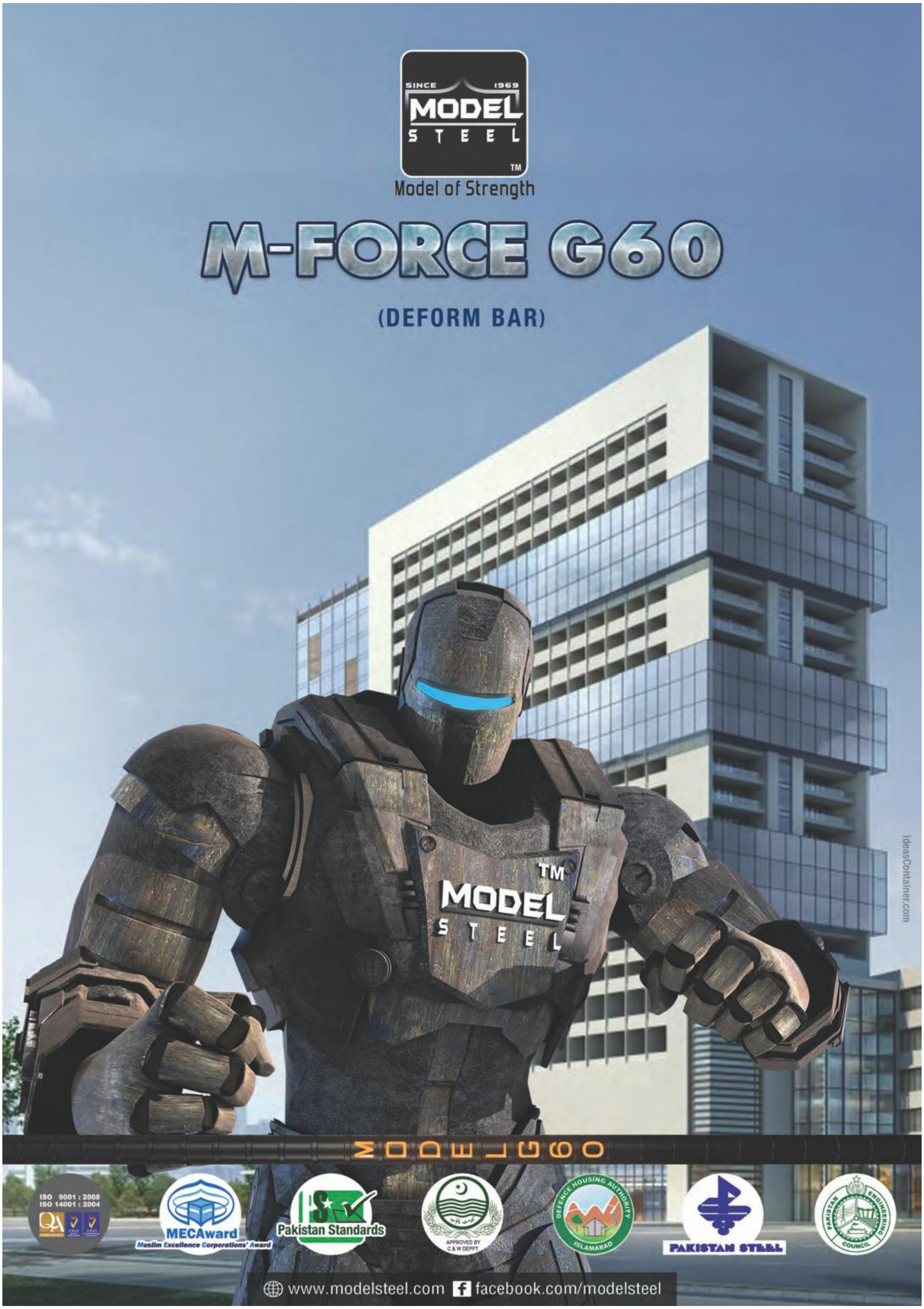

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Aluminium Casting Defects Some Case Studies

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Read also in 3rd Qtr 2017 Element Magazine on Page 14 "Modern high Pressure Die-casting Processes for Aluminium Castings"

To stay in the market with "Cost & Cast" competitiveness, achievement of lowest or zero defect production is very vital.

Introduction

Japanese Canon production system classifies the wastes in any company under 9 categories. One of them is 'Waste due to defective castings'. It is needless to say that in the aluminium casting production, it is important to eliminate this waste. To stay in the market with "cost & cast" competitiveness, achievement of lowest or zero defect production is very vital.

The objective of this paper is to present some real life case studies which will illustrate how occurring of some defects in some critical castings were solved. The lessons, thus learnt, may be applied in some similar situations by foundrymen who are always in the midst of problems and look for solutions.

Case study No 1

Name of casting: Housing, Alloy: LM25, Shot wt: 1.5 kg, Fettled wt: 0.750 kg Quality Parameter: In the 29 mm Dia Bore even a single dot of porosity is not allowed.(Fig 1). Casting Process: Gravity die casting.

Fig1: Critical bore is 29 dia, inside

Defect reported :

Heavy shrinkage in the as-cast, 29 mm dia bore. After machining odd shaped shrinkage was noticed (Fig 2).

Fig 2: Shrinkage in the 29 dia bore

Observations made on the Shop-floor

The die was being poured by two operators, through two Runners (Fig 3). This was peculiar for such a small casting. Metal temperature : 740 0C, uncontrolled.

Severe flow lines were noticed on the outer surface of the casting.

Fig:3. Full shot casting with Risers & Runners and gate entries for metal into the cavity

Fig.4: Shrinkage noticed below this heavy section, inside the 29 Dia Bore

Investigations made:

In casting, there is thick, triangular-shaped portion above the shrinkage area (Fig 4).

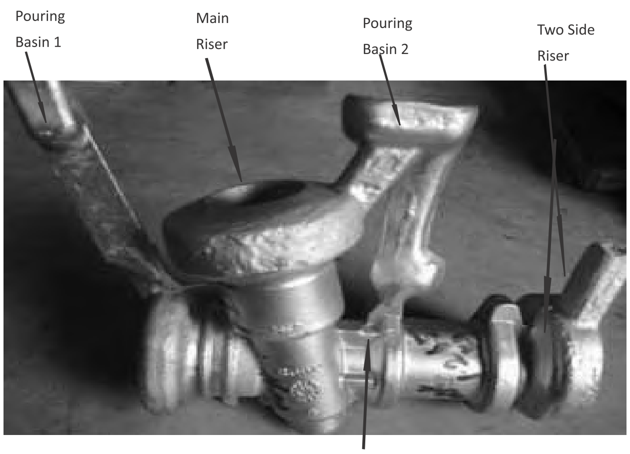

Fig 5: Small riser

The small riser, above the triangular portion was not effective. It was 'Necking' due to non-availability of space. The shape is triangular and thick by virtue of design.

Why shrinkage at this place?

No feeding was coming from the main Riser or from the side Riser or from the small Riser above the triangular boss.

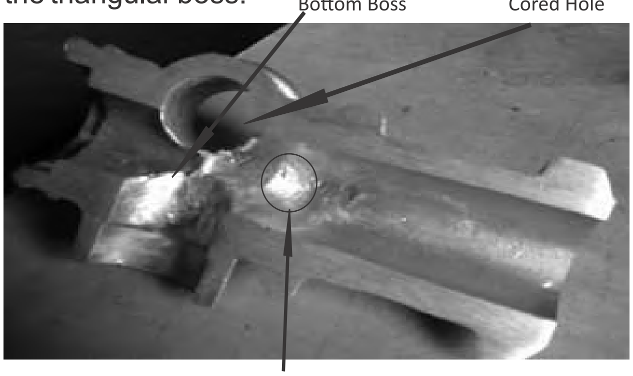

Fig 6: Shrinkage. Section X-X.

Cored hole prevents metal feeding from the top riser when the bottom boss sucks metal from the side which causes shrinkage.

There was no way for getting feed metal for this place. Therefore, shrinkage occurred due to lack of feeding in the 29 dia Bore. This portion is totally isolated from the main risers and also getting over-heated. Thermograhic picture showed this.

Corrective Actions taken

The existing pouring basins 1 and 2 were removed. One new 1:4:2 running system was provided (Fig 7).

The side risers' height was increased for improving feeding (Fig 8).

The ID of the top core was reduced by 2 mm to improve feeding.

Fig 7: Modified running system with 1:4:2 ratio, single pouring Basin was provided

The corner radii were increased from 1 R to 3 R mm. There was some improvement. But still some amount of shrinkage was noticed.

Fig 8: Side riser height was increased, for improving feeding. The Head which force the hot metal into the shrinkage area

To solve the remaining mild shrinkages, a special long copper chill was newly designed, manufactured and fixed tightly as shown in Fig 9. A chill must always be with a 2D Head and exposed to atmosphere for better cooling.
Copper conducts heat five times faster than steel. The demand for hot metal will come down. Thus, shrinkage could be solved / reduced.

Fig 9: Side core with Long copper chill, which was inserted with tight fit, inside the core, by making a long bore.

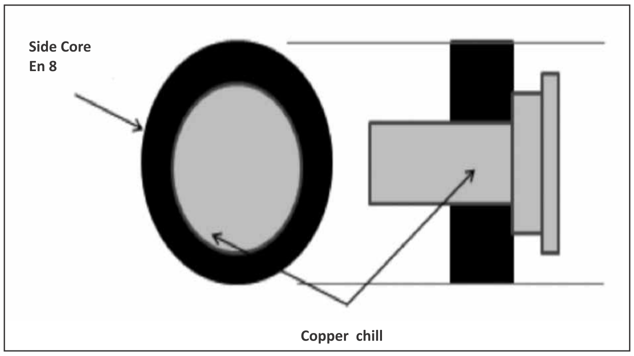

Fig 10: Another view of chill. Copper chill assembly with steel side core

Result

Casting batches were produced and machined. No shrinkage was noticed in the 29 dia bore after machining.

Some theoretical information for solving Shrinkage

Volumetric shrinkage (Pure aluminium :6.6%) of liquid aluminium is the basic reason for solidification shrinkage defects. Some methods are available to solve the problem.
Append to bring down the liquid aluminium metal temperature to lower levels, without causing cold shuts.
Providing enough liquid metal to the shrinking areas. Cooling the shrinkage areas in the die cavity

- Die coat removal at local spots in the die cavity
- Air Jet cooling from behind through sintered vent plugs
- Providing copper chills

Reducing 'Inclusion' content in the molten metal, by using higher ingot to scrap ratio and carry out degassing very well, because Inclusions encourage 'nucleation of shrinkage. Selection of methods is to be done depending on the situation.

Case Study No 2

Name of casting :

Body, Alloy : LM25, Casting wt : 2.8 kg, Full shot wt :4.8 kg, Process : Gravity Die-casting

Defect Reported :

Air Blow Holes were consistently occurring in the 120 Dia bore noticed only after machining (Fig 11). The defect Matrix Diagram, confirmed the location which is not shown here.

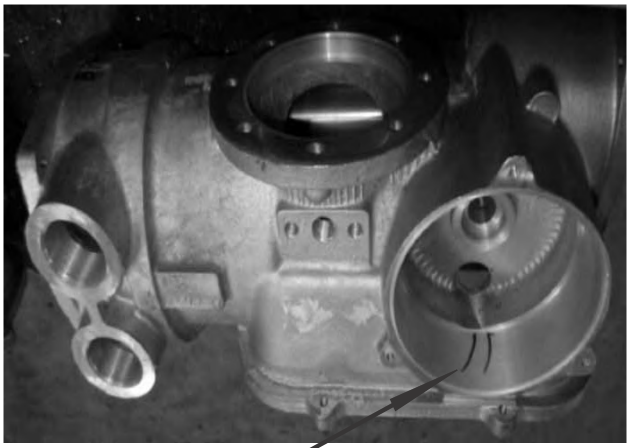

Fig 11: Air Blow Hole area, on the machined bore,120 dia. The shape of the defect was round, bottom surface was grey coloured with little undulations.

Observations made on the shop-floor

Metal Temp: 760 C, But uncontrolled.
The die was being poured by two operators, through two uncontrolled Runners (Fig 12).This was peculiar for such a small casting.
There are 3 Big cores in the metal flow path. This caused metal splashing. This phenomenon was confirmed by severe flow lines and knit marks, seen on the as-cast surface of the casting.

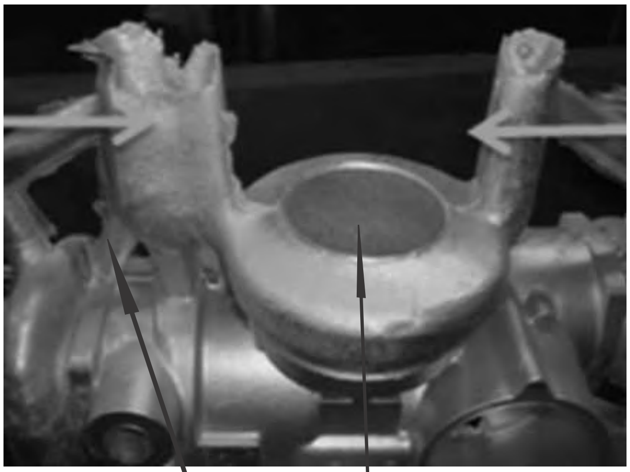

Fig 12 : Two Runners and Metal was poured through both the runners. No control system in the runners

Another observation was " Heavy Aluminium pick-up" on the steel core which forms the 120 dia Bore. The aluminium pick-up was heavy in the bottom side of the core (Fig 13).

One another peculiar observation was that the "Periodical Die coat touch up work" was not done by the Die operators. This was strange. When

Fig 13 : Aluminium metal pick-up on the 120 dia core, noticed after removing the die coat

asked about this, it was replied that the 120 dia core cannot be removed from the die for cleaning & die coat touch up during production. This was Fixed firmly with moving die half with lot of screws and fasteners. Therefore, aluminium metal started sticking on the core surface once the first initial die coating had worn out. Whenever there is no die coat on the iron surfaces, a defect, called 'Flutter' occurred. This defect is similar to Air Blow hole.

All the above were the causes of Air Blow holes in the 120 Dia bore.

Corrective Actions taken:-

- At first Wire mesh Filters were kept in the Runners to reduce turbulence while pouring. But it did not help much.
- Air venting was increased in the die halves and on the core shanks. Only little improvement noticed.
- It was proposed to modify the 120 dia core and the guide bore in the Right die half for easier removal. It was found impossible.
- The die design was re-studied for providing side gating with controlled running system, thus avoiding metal splashing. It was found not feasible in the existing die.

Therefore this existing die was scrapped. A new die was made with side gating & Running system and with other changes as proposed. Casting was produced (Fig 14).

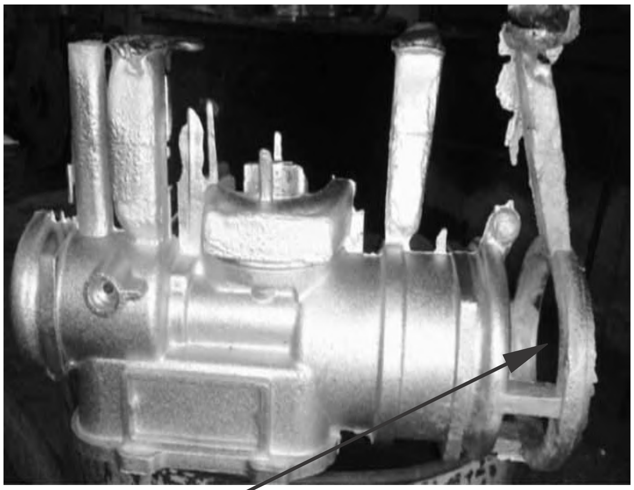

Fig:14. New running system, with side gating encircling the side core at the parting line, one man was sufficient for pouring

Result:

Castings were produced and machined. No Blow Holes occurred in the 120 dia Bore.

Case Study No 3

Name of casting :

Housing, Aluminium Alloy : LM 4, Shot wt : 1.2 kg, Fettled wt : 0.720 kg Process : Gravity Die-casting (Fig 15)

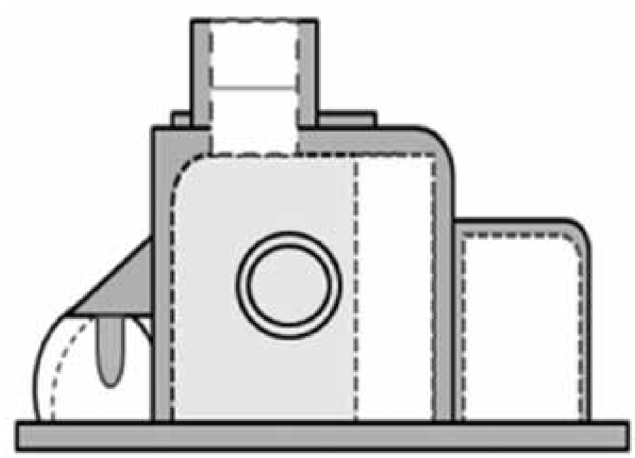

Fig 15: Aluminium Housing casting, Fettled state.

Defect noticed:-

The 10 dia x 24 deep boss was not forming fully (Fig 16). It was a short fill.

Observations made on the shop-floor

- The die cavity portion which formed the boss was, studied very closely.

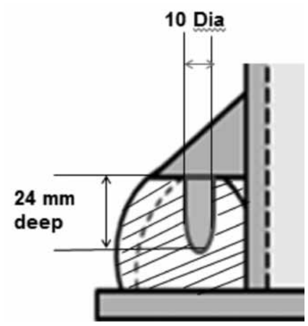

Fig 16: The 24 mm long boss was not forming fully. Only about 10 to 12 mm was forming

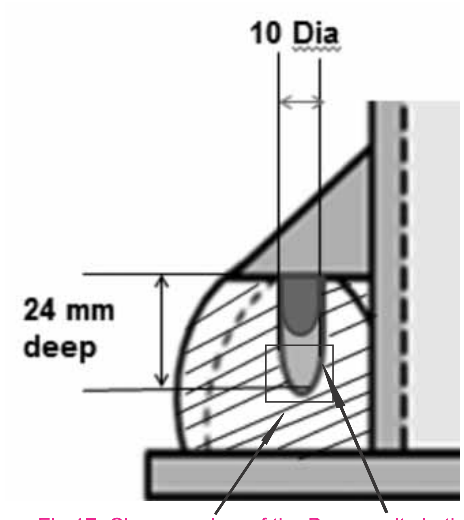

Fig 17: Close-up view of the Boss cavity in the die cavity Insert. The white die coat was not reaching the full cavity. No venting below the 10 dia Boss

- Die coat spraying method was also closely watched. The coating was not reaching the full depth of the 24 mm long boss. Moreover, the operator could not see the bottom of the cavity.

On examination with a pen torch light, it was found that the white colour, die coat had reached only 10 to 12mm depth .In the remaining area. No Die coating (Fig 17).

The Boss cavity portion of Die insert was also made as an integral part of the main big core. Unable to remove it for coating purposes. Also there was no Air venting at the bottom of the boss (Fig.17).

- **Corrective Actions taken:**
- The portion of die Insert, which formed the boss portion, was made as a separate piece. Again this separate piece was split into two halves so that the operator can easily apply die coat on the full length boss in the cavity. Then it can be assembled together and fixed in the main core by means of Dowels (Fig 18)
- An Air vent plug was provided at the bottom of the Boss as shown in Fig 18:

Result :

Castings were produced. The boss was perfectly forming to the full length of 24 mm.

Remarks:

Although the Dies were being designed well, using CAD facilities by taking care of all the production aspects, still some practical difficulties can cause defects in the castings. Hence, all the die design work is to be discussed with Sr. die operators and supervisors before finalisation of die manufacture.

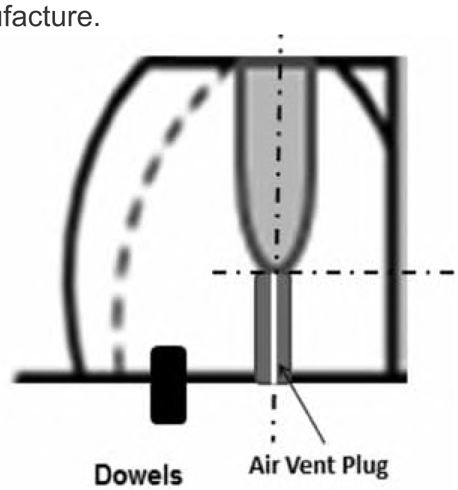

Fig 18: The Boss cavity Insert was split in two separate pieces

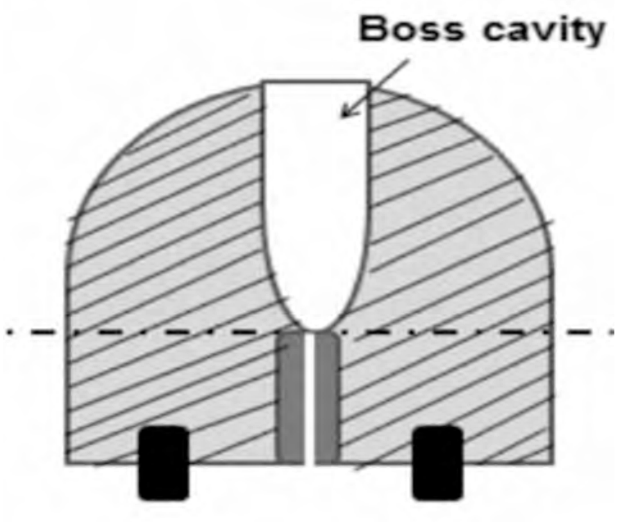

Fig 19: Cut section view of the Boss cavity

Conclusions

- From the above 3 case studies the following lessons are learnt:

- From the first case study, it was learnt that when proper risering is not possible in a casting, the next option available to solve shrinkage is 'Cooling ' by Air, or Spot chilling by die coat removal at local spots or providing well-designed copper chills.

- From the 2nd case study, it was learnt that filling the die with molten metal with minimum or no turbulence can prevent Air Blow holes. Here, it was also seen that by improper design of the cores, die coat application was very difficult during production, which can also lead to defects.

- In the 3rd case study, again Die coat application played a major role along with Air venting. Improper die design can cause defects. Any deep cavities must be vented properly along with ease for die coating.

The die design is a combined responsibility of the Die Designer, Operators, Tool makers and Quality personnel.

Sampling and Testing of Silica Foundry Sands

J. F. Meredith
Casting Solutions Pty Ltd

Part 1

Sampling of sand for testing

All sand tests should be performed on samples, which are representative of the parent material.
The fundamental objective in sampling is to obtain a random,representative sample.This usually requires taking three samples: one each from the front, rear and centre of the sand heap, at a depth ofnot less than150mm, to yield one representative sample when mixed.
Samples may also be taken from the mixer, conveyor belt, or sand hopper of a sand system. Figure 1 shows the use of a sampling tool to extract a sample from a sand heap. Due to segregation during transportation, handling and flow through silos, the taking of samples from silos cannot be considered to be representative even if samples are taken at different heights in the silo. A single sample taken directly from the silo outlet is equally unrepresentative.
A reasonably representative sample from a silo is only possible by the mixing of several individual samples taken from the outlet over an extended time period.

FIGURE 1. Using a sampling tool to obtain a representative sample.

Determination of moisture content

As moisture content affects so many properties of the sand, it is one of the most important and frequently performed tests. Moisture content may be determined by loss of weight after evaporation. One type of instrument designed for this purpose is shown in Figure 2. This instrument utilizes a heating lamp enclosed within a cabinet. The sand sample is placed on a balance scale mounted tray below the lamp. As moisture is lost by evaporation, the percentage of weight loss is indicated on the dial connected to the balance scale. Moisture content may also be determined by heating a sample of sand in an oven. A typical procedure would be:

1. A 50-gram sample of tempered sand is weighed, dried at 110°C for two hours, cooled to room temperature in a desiccator, and reweighed.
2. Moisture content is expressed in per cent by weight and is the loss of weight noted after drying the sample. Moisture content may also be determined by means of a chemical reaction.

1. A 10-gram sample is weighed and placed in a sealed pressure vessel along with a measured amount of powdered calcium carbide. The reaction between the moisture in the sand and the calcium carbide will produce an amount of acetylene gas proportional to the amount of moisture in the sand. The instrument used is known as the Speedy Moisture Tester and is shown in Figure 3.
2. Moisture content is read directly from a calibrated scale on the instrument.

Determination of clay content

Clay content is determined by loss of weight after washing a sample. The AFS clay content of a sand is defined as “particles which fail to settle one inch per minute when suspended in water. These are usually less than 20 microns in diameter”.

1. A 50-gram sample of previously dried sand is weighed, placed in a mixing device such as that

shown in Figure 4, and treated with a standard sodium hydroxide solution under controlled conditions.

2. Agitate for 5 minutes with a mechanical stirrer, then dilute with water to a height of 150mm and allow settling for 10 minutes.

3. Siphon off 125mm of water, dilute again to 150mm height, and allow settling for 10 minutes.

4. Siphon off 125mm of water, dilute again to 150mm height, and allow settling for 5 minutes.

5. Repeat step 4 enough times so that, after standing for 5 minutes, the water is clear.

6. Remove the remaining sand from the bottle, dry and weigh. Loss of weight is a measure of clay substance and may be expressed in per cent by weight.

The clay must be removed from all sands containing more than 1per cent clay if it is intended to perform sieve analysis on the sand.

FIGURE 2. Evaporative moisture determination instrument.

FIGURE 3. Speedy Moisture Tester.

FIGURE 4. Clay determination apparatus.

FIGURE 5. Sieve analysis apparatus.

Sieve analysis

Sieve analysis is performed using the residue from the preceding test. The objective is to determine the per cent of different sizes of sand, silt and clay.

1. The dried residue, which is generally slightly less than 50-grams, is placed on top of a series of sieves in a mechanical shaker and shaken for 15 minutes. See Figure 5.

2. The series of sieves provide a continuum of decreasing mesh sizes from top to bottom. Mesh numbers are 6, 12, 20, 30,
40, 50, 70, 100, 140, 200 and 270. Smaller particles, which pass the 270 mesh, are trapped in a pan at the bottom of the stack of sieves.

3. After the shaking period, the sand retained on each sieve and the pan is weighed, and its percentage of the total sample determined.

4. The data obtained from the individual sieves can be plotted to develop a distribution curve showing the per cent retained on each sieve. Also, an average grain fineness may be calculated. To calculate the average grain size, the per cent retained on each sieve is multiplied by a factor, which is the size of the preceding sieve. The average grain fineness number is equal to the sum of the sieve number and factor product divided by the total percentage of sand grains retained on the sieves and pan.

Part 2

Preparation of standard test specimens

A controlled mass of moulding sand rammed to a specific size is called a standard test specimen. As the strength of a moulding sand depends greatly on its degree of ramming, the conditions of ramming the standard sample must be carefully controlled.

FIGURE 6. Standard sand rammer, specimen tube and stripping post.

1. The most commonly used standard test specimen is the 2-inch diameter by 2-inch long specimen.

2. The standard specimen tube controls the diameter. The specimen tube is closed at one end with a pedestal; a quantity of sand is placed into the tube and rammed according to the procedure for the specimen being used. The most common procedure is to use three rams.

3. The specimen rammer is a devise that provides a controlled weight falling a prescribed distance in order to compact the sand in the tube. See Figure 6.

4. After ramming, the specimen may be removed by means of a stripping post, which fits inside the tube, or it may be retained in the tube depending on the test being conducted.

Determination of permeability

Permeability is expressed as the volume of air in cubic centimetres that will pass per minute, under a pressure of 1 gram per square centimetre, through a specimen of sand 1 square centimetre in cross sectional area and 1 centimetre in height.

1. The permeability test is performed with the standard 2-inch diameter by 2-inch high specimen retained in the specimen tube.

2. The tube with specimen is placed on the permeability meter and a selected amount of air is forced through the specimen under controlled conditions. One end of the specimen tube is sealed to the instrument so that the air must pass through the sand specimen in order to escape.
See Figure 7.

3. The rate of flow of air is timed in order to calculate a permeability number. The relationship of the variables can be expressed as follows:

$$P = vh/pat$$

FIGURE 7. Permeability meter.

Where:

P = permeability number

v = volume of air passing through specimen in cubic centimetres.

h = height of specimen in centimetres.

p = pressure of air in grams per square centimetres.

a = cross sectional area of specimen in square centimetres.

t = time for air passage in minutes.

The standard procedure requires 2,000 cubic centimetres of air to pass through a specimen of sand 5.08 centimetres (2 inches) in height and 20.268 square centimetres (3.1416 square inches) in area. These known values can be substituted for v, h and a. The permeability metre is designed to produce a constant pressure of 10 grams per square centimetre, regardless of rate. Substituting these known Permeability Is Expressed As The Volume Of Air In Cubic Centimetres That Will Pass Per Minute, Under A Pressure Of 1 Gram Per Square Centimetre, Through A Specimen Of Sand 1 Square Centimetre In Cross Sectional Area And 1 Centimetre In Height.

FIGURE 8. Sand strength tester.

values and converting minutes to seconds the formula can be further simplified to:

P = 3,007.2/time in seconds

Most permeability metres are equipped with measuring devices for direct reading of permeability number so that calculations are unnecessary.

Determination of strength of moulding sand

Sand specimens may be subjected to forces under controlled conditions so that measures of various strengths can be made.

1. Compression strength is measured when the specimen is caused to break under a compressive load.

2.Shear strength is measured when the specimen is caused to break under a shearing load.

3.Tensile strength is measured when the specimen is caused to break under tension forces.

4.Transverse strength is measured when the specimen is caused to break under a bending load. Compressive and Shear strengths are most often used for testing of green sands using a standard 2-inch diameter by 2-inch high, three ram sample. See Figure 8. It is important in these and other green sand tests that the test be performed immediately after the specimen is stripped from the tube.

1.Compression strength, usually simply referred to as green strength, is obtained by applying a uniformly increasing load to the specimen until fracture takes place.

2.Shear strength is obtained in much the same way as compressive strength; however, the specimen holding devise

FIGURE 9. Green-hardness tester.

is changed so that the load is applied on the upper half of the specimen at one end and on the lower half at the other end. The specimen then ruptures in shear along its longitudinal axis when sufficiently loaded.

Tensile and transverse strength are measured on specially prepared specimens of cured or dried core sand mixtures.

1.Tensile strength is measured using a cured "dog-bone" specimen and appropriate attachments on the strength machine.

2.Transverse strength is measured using a cured specimen, typically 25mm by 200mm loaded with appropriate attachments so that the force is at the centre of the span.

Mould hardness

The hardness of compacted green sand can be measured using a mould hardness tester, which incorporates a spring-loaded ball. See Figure 9.

1.The range of scale is from zero to 100. If no penetration occurs, the hardness is 100, whilst if the ball sinks completely in the sand the reading is taken as zero.

2.Typical mould hardnesses obtained from different green sand moulding machines vary from approximately 80 to 95. n

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2) ***Introduction to Foundry Technology*** *– Ekey & Winter – McGraw-Hill Book Company 1958*

UPCOMING FOUNDRY EVENTS

- IFEX 2018 10-12th January, 2018
  Venue: Helipad ground, Gandhinagar, Gujrat India.
  Contact:www.ifexindia.com.
- 16th China International Foundry Expo (Metal China 2018) May 16-19, 2018 Venue: Beijing, China Contact: www.foundry-china.com
- 7th International Foundry Congress & Exhibition, 2018 November, 2018 Contact: www.pfa.org.pk
- Metal & Steel / FabEx Middle East Exhibition 2018 March 1-3, 2018 Venue: Cairo, Egypt
- International Machinery and Equipment Trade Show - FEIMEC 2018 April 24-28, 2018 Venue: Sao Paulo, Brazil.

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Surface Plasmon Resonance Spectrometer

Reference:- Ninomiya, Tsukuba Japan

The Surface Plasmon Resonance (SPR) Spectrometer, developed in collaboration with Prof. Wolfgang Knoll with Max Planck Institute for Polymer Research (MPI-P) in Germany, allows users to perform a highly sensitive non-label analysis for the interaction of organic molecules (biological molecules etc.) on a surface in real time by utilizing the surface plasmon resonance phenomena. We would sincerely appreciate your consideration of our SPR system for your research uses in the cutting-edge nanotechnology field.

Principle Use

Direct measurement of interaction between DNA/RNA, protein(antigen-antibody), sugar and cells Analysis of adsorption rate and determination of bonding amount and coupling constant.

Features

◎ Label free (no need to use fluorescent dye labeling)

◎ Real-time kinetic analysis of adsorption and desorption phenomena

◎ Flexible system configuration allowing users to customize attachments (electro-chemical cell, CCD camera, temperature control, etc.) to meet the research usage.

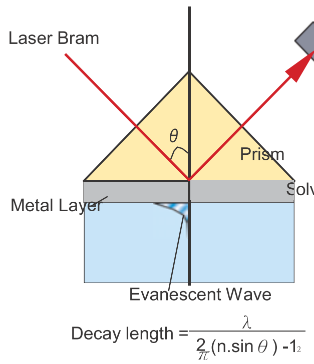
◎ Measurement software using Lab View

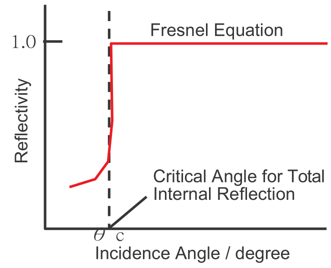
Surface Plasmon Resonance:

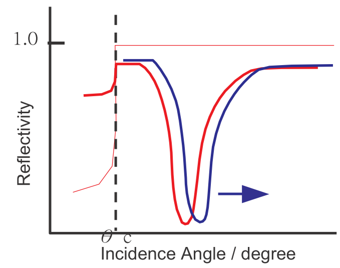
Optical Principle

When the incoming light is reflected on the interface of about 50nm thick metal layer through a prism, at a certain angle of incidence in total internal reflection, the characteristic light absorption (attenuation of reflected light) can be observed. This is the Surface Plasmon Resonance (SPR) phenomena. It is very sensitive to the change of reflective index of the media, i.e. molecular adsorption to the metal interface in the evanescent light distance, and monitoring the change allows high-sensitivity measurement of molecular-adsorption movement on surface.

The irradiated light on the backside is totally reflected and generates the weak energy wave (evanescent wave) on the metal layer side, then the interaction between the materials induced on the sensor-chip surface differ the dielectric constant and influence the surface plasmon. Thus, we can recognize the interaction between the materials as a change of resonance.







Measurement Modes

Angle Scan Mode

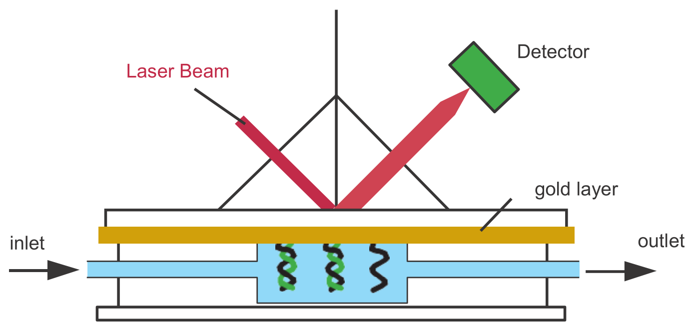
The system sweeps the angle of incidence and monitors the reflected intensity with θ-2θ goniometer.

Angle scan mode allows users to determinate the adsorption quantity of molecules.

Kinetics Mode

The system fixes the angle of incidence and measures the reflected light intensity as a function of time.

Kinetics mode allows users to monitor the adsorption/desorption process of molecules in real time.



◎ Configuration

- Basic SPR optical system size (100 x 450 x 50H)
- θ-2θ goniometer (stepping motor drive)
- He-Ne laser
- Actinometer
- Chopper and Lock-in amplifier
- Attenuator
- Sample holder (holder and LaSFN9 prism)
- PC and Software

◎ Option

- Liquid-flow system
- Temperature control system
- SPR microscope
- Fluorescence microscopy
- Fluorescence spectroscopy
- Grating-coupling SPR etc.

◎ Specifications

- Resolution: Angle resolution $\leq$0.0025°
  Time resolution $\leq$ 0.1 sec.
- Reflectance sensitivity: $\leq$0.1%
- Measurement mode
  - Angle scan mode
    Measurement range: incidence angle of 10° to 90°
    Optical sensitivity of film-thickness : $\leq$1Å
  - Kinetics mode
    Reflectance sensitivity $\leq$0.1%
    Time resolution $\leq$0.1 sec.
- Extensibility:
  - Open unit allows users to customize attachments to meet the research usage

INFINITY SCHOOL OF ENGINEERING
Visit By
Mr. Sikandar Mustafa Khan & Dr. Fazal Ahmed Khalid

A. RazzaqGohar-CEO,
Infinity School of Engineering

INFINITY SCHOOL OF ENGINEERING is registered with Technical Education & Vocational Training Authority and is run and managed by RAVI-INFINITY FOUNDATION. RAVI-INFINITY FOUNDATION is sponsored by RAVI INFINITY GROUP.Infinity School of Engineering provides Education & Training in Engineering and Management disciplines that pursue Knowledge, Skills and Attitude to bridge the existing gap between technical education and industry. All the courses in ISE are developed and improved through educational research and involvement of industries.

On the special request of the Management of ISE, Chairman Millat Group of Companies & President Pakistan Foundry Association (PFA) Mr. Sikandar Mustafa Khan along with Vice Chancellor University of Engineering and Technology Lahore Dr. Fazal Ahmad Khalid and Chairman Qadri Group Mr. Asim Qadri visited Infinity School of Engineering.During his visit, Mr. Sikandar Mustafa Khan admired the "Bridging the gap between youth and industries" initiative taken by the Ravi Infinity Group. He highly appreciated the fully Equipped and Modern labs as well as the facilities including Multimedia Classrooms, On the Job trainings, Industrial Visits, Free uniforms, Transport, Lunch and Hostel facilities provided by Infinity School of Engineering to its students.

Moreover, in this visit, Infinity School of Engineering agreed to share its experience of running technical training institute and will extend all possible support to restart Foundry Service Center specifically for human resource development in modern foundry skills and technologies at Foundry Service Center (FSC).

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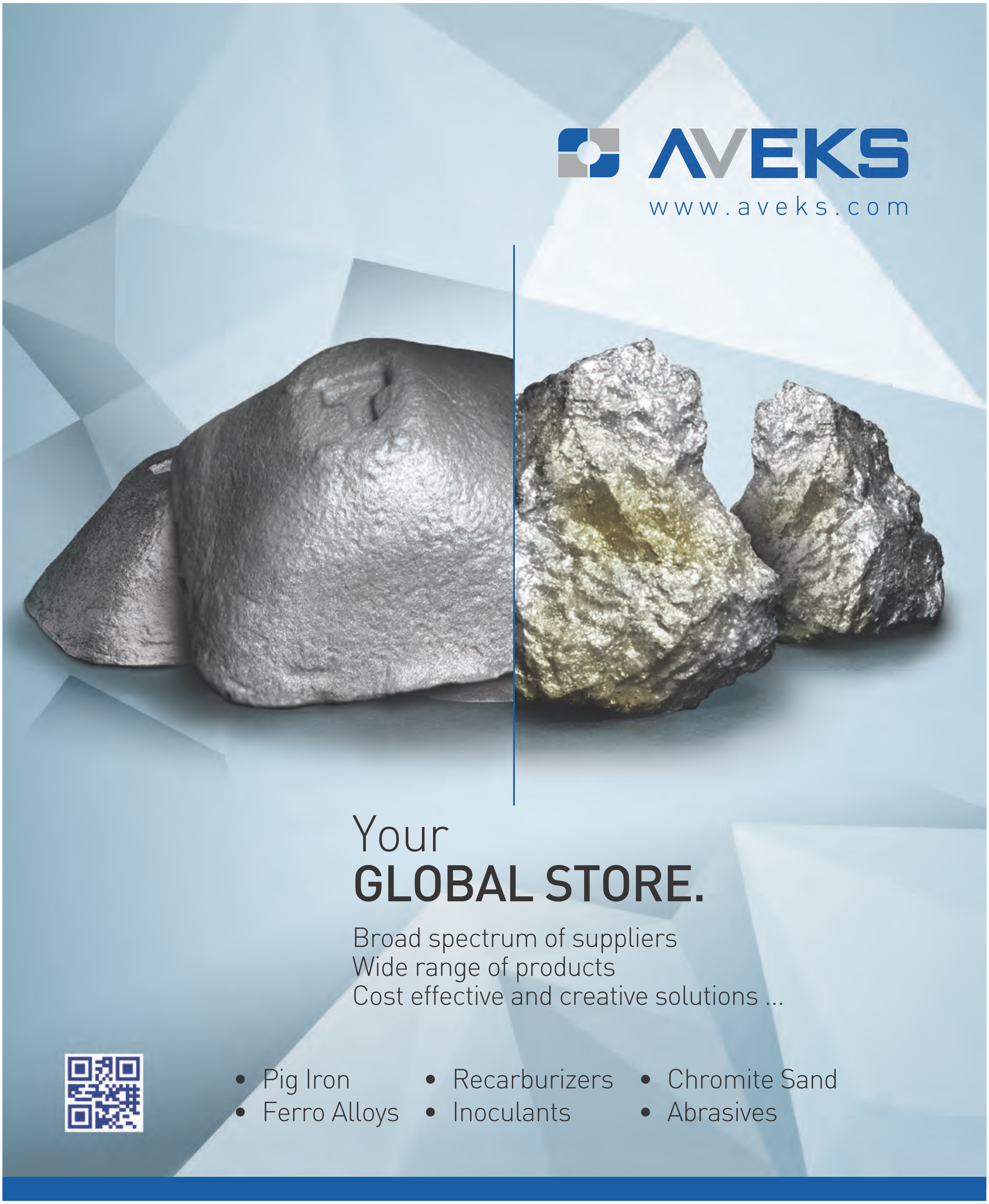
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