CHINA – A SUCCESS STORY

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Abstracts
In 1998 Chinese Refractory Products were introduced into the UK/European steel industry for the first time. This paper details the initial results achieved and from that result the continued development of lining concepts for ladles, EAF's and BOS converters in a UK/European group of companies. The paper also traces the parallel development of the production facilities of Mayerton Refractories Ltd in China culminating in the commissioning in 2007 of a new state of the art production facility in Dalian China.
Key word: Chinese refractories.

CHINA – UMA HISTÓRIA DE SUCESSO

Resumo
Em 1998 a Produtos Refratários Chineses foram introduzidos nas siderúrgicas do Reino Unido/Europa pela primeira vez. Esse trabalho detalha os resultados iniciais obtidos e desde então quais foram os desenvolvimentos continuados nos conceitos de revestimentos de Panelas, Fornos Elétricos a Arco e Convertedores LD em Grupos Siderurgicos do Reino Unido/Europa. Esse trabalho traça um desenvolvimento paralelo do processo de produção da Mayerton Refractories Ltd na China, culminando em 2007 com a inauguração de uma fábrica que representa o estado da arte na fabricação de refratários.
Palavra-chave: Refratários chineses.

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Mayerton Refractories Limited was originally a trading company sourcing and supplying refractory products into Russia. In 1998 based on that success the board of Mayerton Refractories Limited decided to establish a new company and to begin business in Europe
Given an opportunity by a European steel producer, who was beginning to assess potential alternative refractory suppliers through out the world Mayerton were charge with sourcing ladle linings for an integrated mill.
The remit was to find an equivalent to the material then in use (Chinese Type B) and to find the best materials available (Chinese Type A and Chinese manufacturer B)
The materials in use giving the UK average shown below were majority sintered material with a fused grain addition, one resin bonded and the other pitch bonded, at the time both materials performed very similarly.

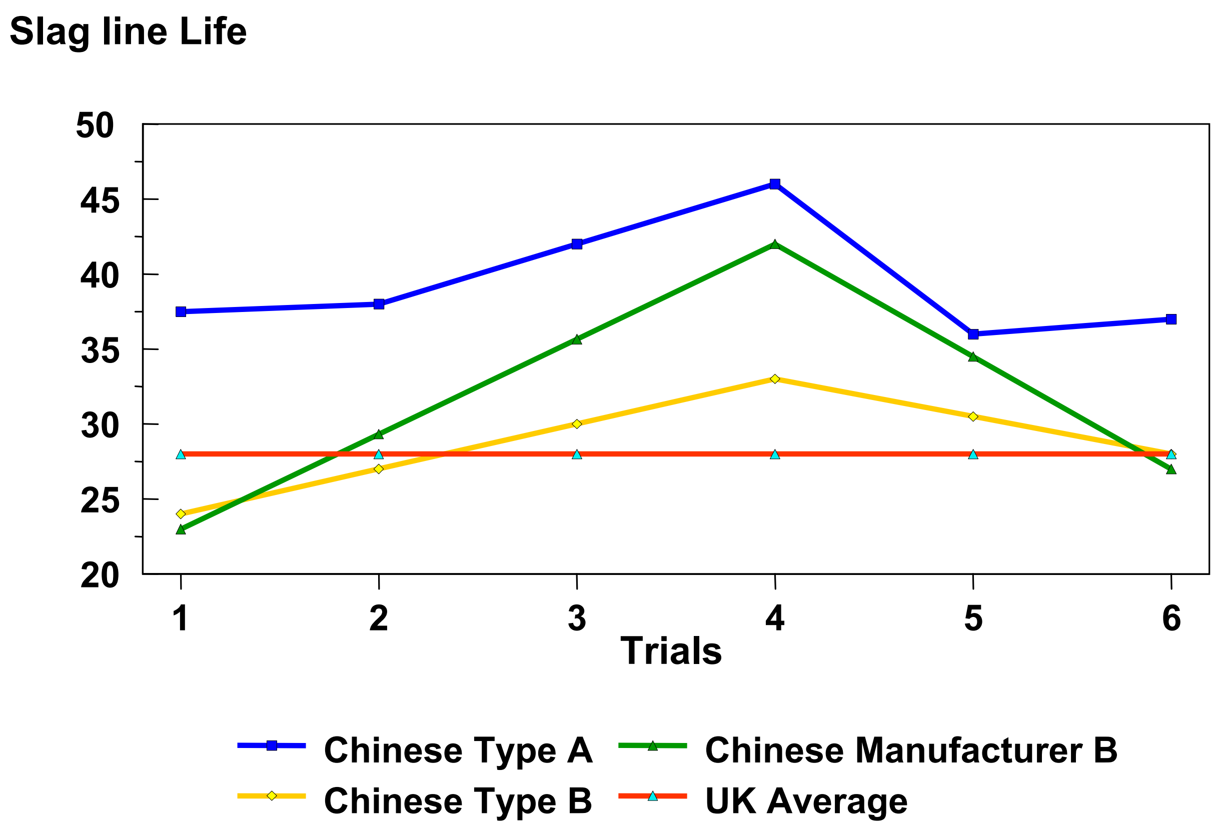

Figure 1. Slag line life from different sources

Working with Mayerton technicians in China the materials selected were:
a) Chinese Type A – based on a 98% fused grain material with anti oxidants
b) Chinese Type B – based on a 97% fused grain material with anti oxidants
c) Manufacturer B – based on 98% fused grain material with anti oxidants
All three materials were resin based, the combination of anti oxidants was different from Manufacturer B.
Based on the success of the first 18 ladles as shown above, the barrel material which was originally over engineered, (as a performance problem on the first trials would not have been well received) – was modified to find the most cost effective and

operationally safe combination of carbon content fused grain composition and level of anti oxidants. Barrel lives in excess of 120 heats are regularly achieved and coupled with 2 slag line and 2 bottoms lives up to 145 are achievable.

In 2001 with a growing business the company realized its long term ambition to become a producer in its own right, once established as a producer acceptance in the market place became easier and the level of business grew rapidly.

Further development with the customer also enabled a simplification of a long standing ladle design by the elimination of several brick shapes and material positions.

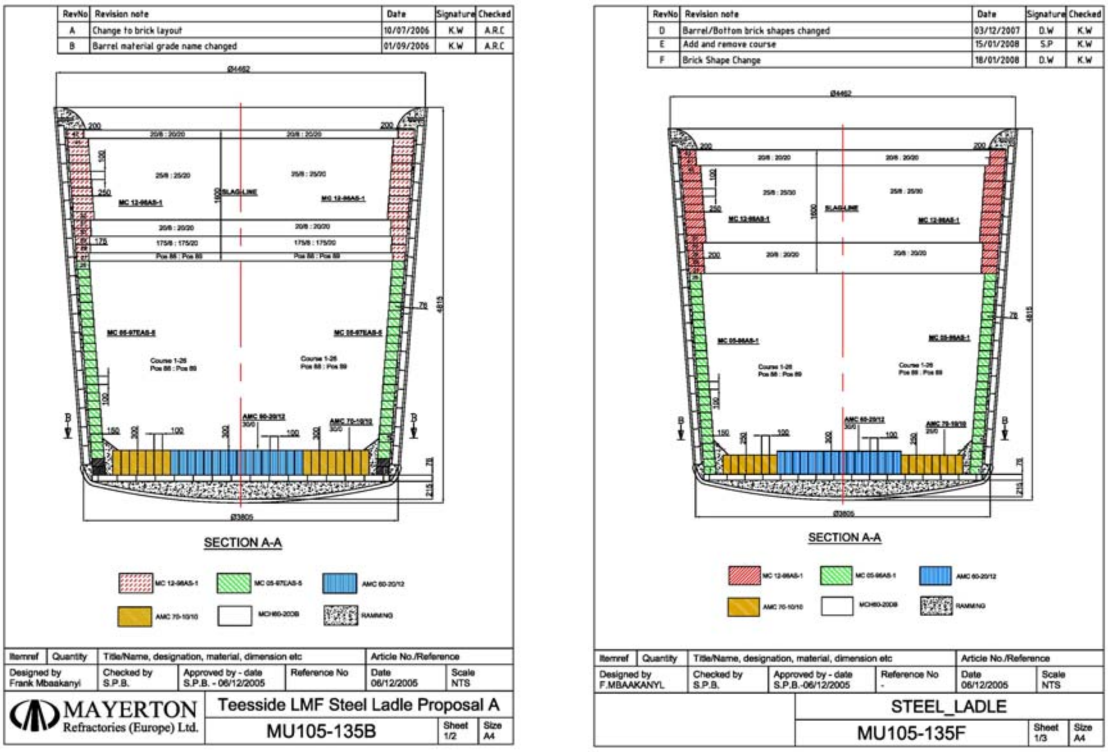

Figure 2. Ladle designs

Material development work was ongoing at a second plant to trial and establish a cost effective one shot ladle when an executive decision was taken to increase the quality of its tyre chord qualities and it was deemed necessary to remove as many sources of potential alumina as possible. The decision was taken to remove all the alumina deoxidants from the ladle bricks.

Below details the work that was done with material compositions to achieve this requirement but maintain the ladle performance. The material in use prior to this decision was typically a 100% fused grain material utilizing dual Aluminium and Silicon metal anti oxidants with a typical carbon level of 12%

For initial assessment three ladle lining were supplied, the plant operates with a typical campaign life of 100 heats utilizing a bottom change and slag line repair of varying degree around the 60 heat mark.

The plant operates a laser measuring system with a requirement that any ladle repair or end of campaign is scanned out of service. To assess performance it was agreed to utilise the last scan of the first slag line to determine a wear rate in mm per heat.

Table 1 - Situation mid 2006

Slagline

Wear

(To first S/L repair):- Trial 1 Trial 2 Trial 3 Trial 4

n	Non-trial	MC12-98AS-2G	MC12-98AS-7	MC12-98-1SB	MC12-97E-7SB
	(mm/heat)	(mm/heat)	(mm/heat)	(mm/heat)	(mm/heat)
1	2.63	3.02	2.52	2.77	2.27
2	2.15	2.61	3.78	2.75	1.82
3	3.80	no scan	3.18	2.19	2.40
4	3.44				
5	4.10				
6	2.49				
7	2.42				
8	3.85				
9	3.06				
Ave	3.10	2.82	3.16	2.57	2.16
S.D.	0.72	0.29	0.63	0.33	0.30
Range	2.15 - 4.10	2.61 - 3.02	2.52 - 3.78	2.19 - 2.77	1.82 - 2.40
n	9	2	3	3	3

Comments on Table 1 performance:

Trial 1 - Modified graphite trial showed improvements in the wear rates and was adopted;

Trial 2 - introduction of sinter did not improve the performance;

Trial 3 - introduction of a soft bond technology gave an improvement;

Trial 4 change of fused grain component, addition of sinter and sot bond technology gave an increased performance and achieved the elimination of the anti oxidants

To eliminate the anti-oxidants the Trial 3 material became the new standard for the shop but development work continued with the trial 4 material which still gave improved performance in the slag line. See Table 2.

Table 2. Trial 4 – Results

Slagline Wear

(To first S/L repair):- For period Sep 06 - Jan 07.

Ladle	MC12-98-1SB		Ladle	MC12-97E-7SB
	(mm/heat)			(mm/heat)
66	3.87		60	2.18
55	1.93		51	2.24
50	3.61		62	3.62
57	4.55			
51	3.98			
55	n/a			
55	2.33			
53	2.49			
54	n/a			
67	2.38			
66	2.28			
Ave	3.05		Ave	2.68
S.D.	0.95		S.D.	0.81
Range	1.93-4.55		Range	2.18-3.62
N	9		n	3

The ladle contains one material in both slag line and barrel and the work was also conducted in the ladle barrel with different results. As reported earlier the ladle has to be scanned at the end of campaign so wear rates were calculated at the end of campaign for the barrel.

Table 3 - Situation mid 2006

Sidewall Wear

(To end of campaign)

N	Non-trial	MC12-98-1T		MC12-97E-7T	
	(mm/heat)	(mm/heat)		(mm/heat)	
1	1.49	1.16	(L60)	1.55	(L65, 106hts)
2	1.67	1.32	(L64)	1.40	(L60, 101hts)
3	1.65	1.33	(L50)	1.48	(L59, 103hts)
4	1.48				
5	1.40				
6	1.41				
7	1.49				
8	1.28				
9	1.44				
10	1.58				
Ave	1.49	1.27		1.48	
S.D.	0.12	0.10		0.08	
Range	1.28 - 1.67	1.16 -1.33		1.40 - 1.55	
n	10	3		3	

Table 4. Wear out rates
Sidewall Wear
(To end of campaign) For period Sep 06 - Jan 07.

Ladle	MC12-98-1SB		Ladle	MC12-97E-7SB
	(mm/heat)			(mm/heat)
66	1.23		60 (83 hts)	1.42
55	1.27		51 (95 hts)	1.42
50	1.27		62 (89 hts)	1.58
57	1.09			
51	1.01			
55	1.21			
55	0.92			
53	1.67			
54	0.85			
67	n/a			
66	1.36			
Ave	1.19		Ave	1.47
S.D.	0.24		S.D.	0.09
Range	0.85 - 1.67		Range	1.42 - 1.58
N	10		n	3

Table 5. Wear out rates
Sidewall Wear
(To end of campaign) For period Sept 07 - Jan 08

Ladle	MC12-98-1SB		Ladle	MC12-97E-7SB
	(mm/heat)			(mm/heat)
68	1.41		59	faulty scan
55	1.80		51	1.62
58	1.37		68	1.87
57	1.23		65	1.67
58	1.11		69	1.73
Ave	1.38		Ave	1.72
S.D.	0.26		S.D.	0.11
Range	1.11 - 1.80		Range	1.62 - 1.87
n	5		n	4

The obvious conclusion is to have a mixed ladle configuration and these discussions are currently ongoing.

EAF's

Primarily Mayerton supplied a 100% fused grain material to the EAF furnace but significant improvements were with material developments including an increasing percentage of sintered materials. In addition the physical build of the furnace can have a significant effect on its performance.

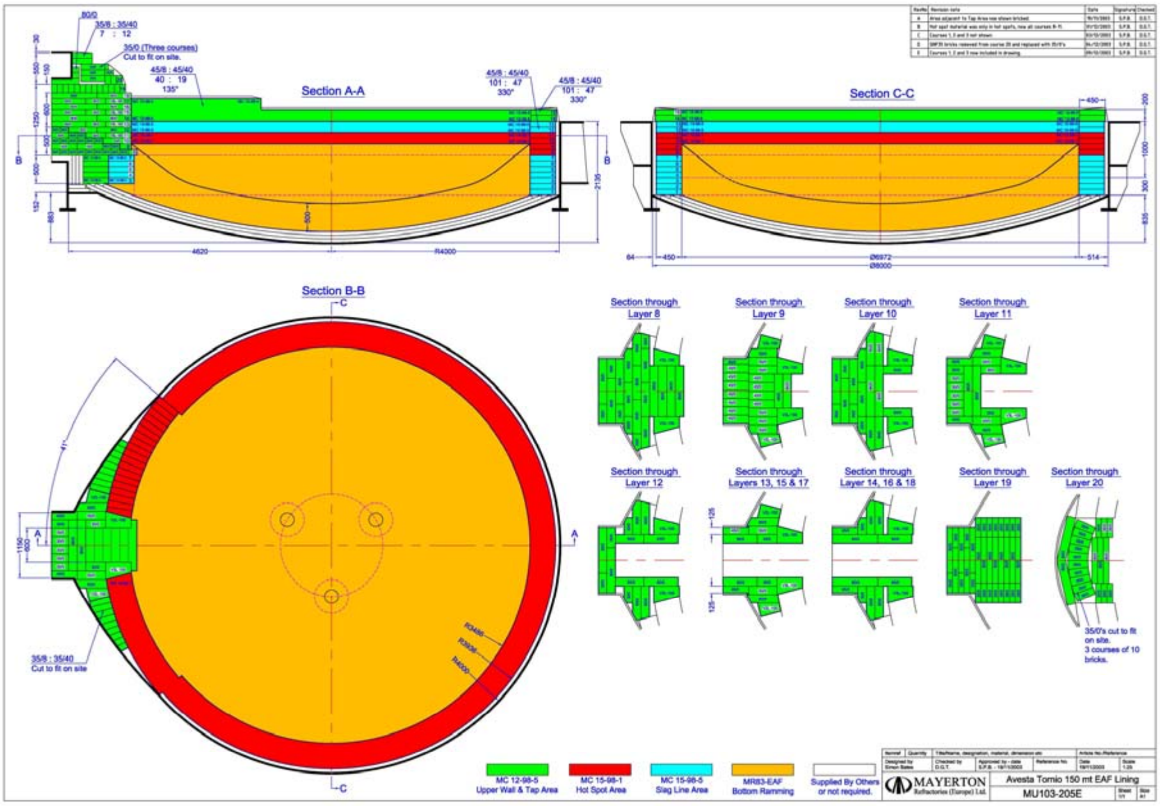

Figure 3. Typical Eletric Arc Furnace Profile

This furnace had two particularly problems in the nose area, 1) retention of the wall at the end of the sweep and 2) retention of the tapping hole integrity through the campaign. These two problems were solved by the development of a "lego" brick and a "T" shaped brick as shown below.

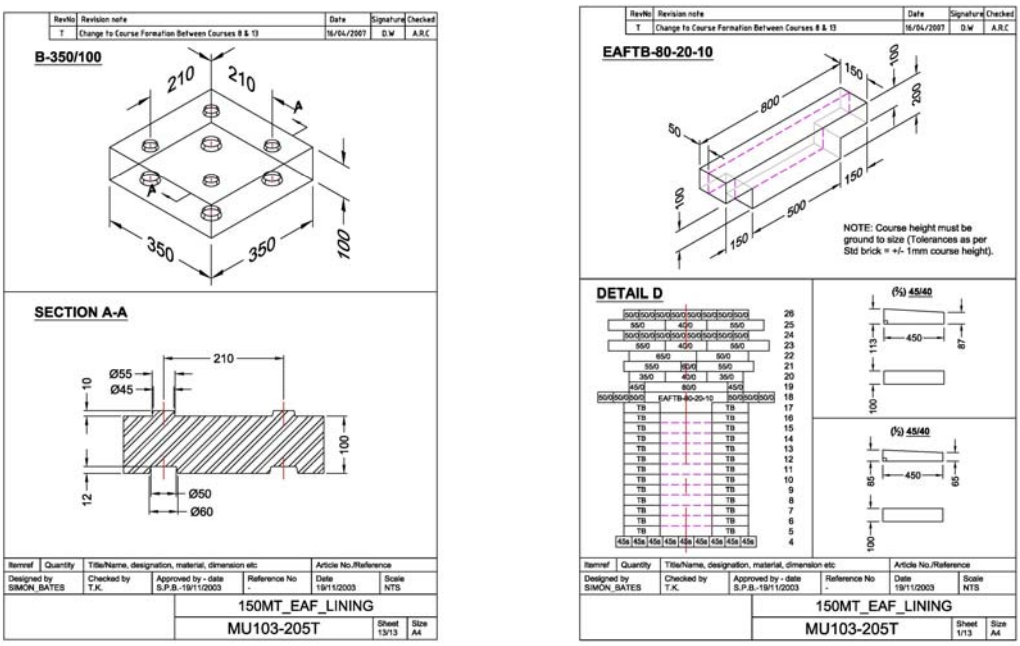

Figure 4. Details of Bricks for EAF Lining

With a growing success rate in ladles and EAF'f the company proposals on Converter design were taken seriously and in 2004 the company secured its first converter lining in Western Europe. Following its successful campaign repeat order were achieved and an expanding reference list developed. In January 2008 the company secured it first radial design converter. This converter is currently on the water and will be built in June. As part of the process and to ensure that taper selection was correct a pre assembly was conducted at our manufacturing facility in China.

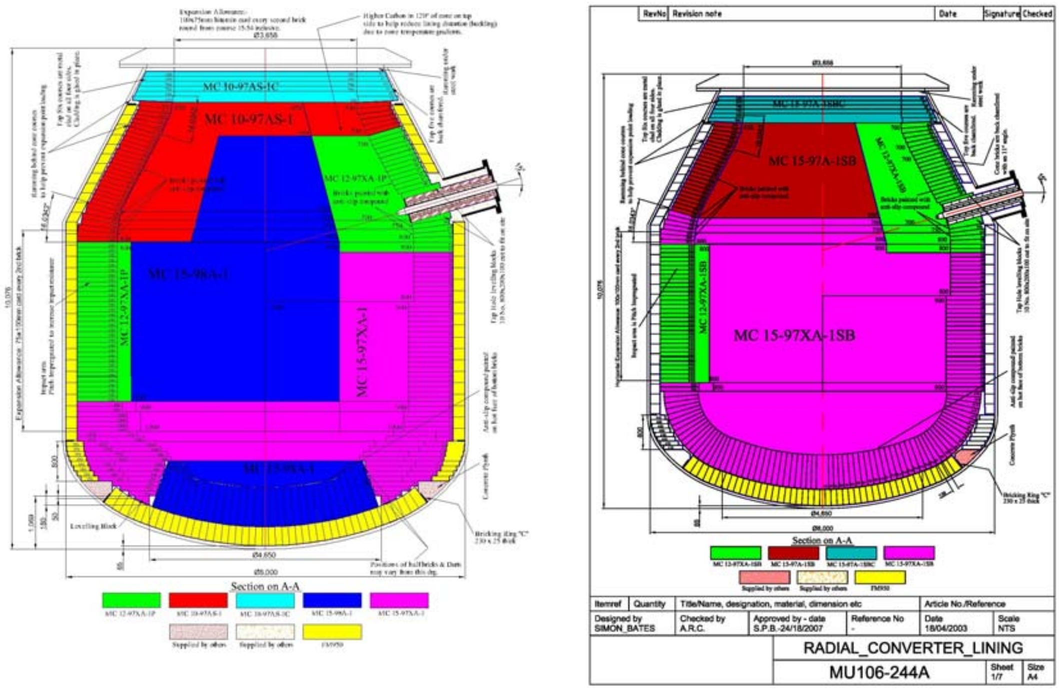

Figure 5. Typical Converter Linings

Mayerton had become a producer in 2001 with its first production facility in China, the out put through the years is shown below.

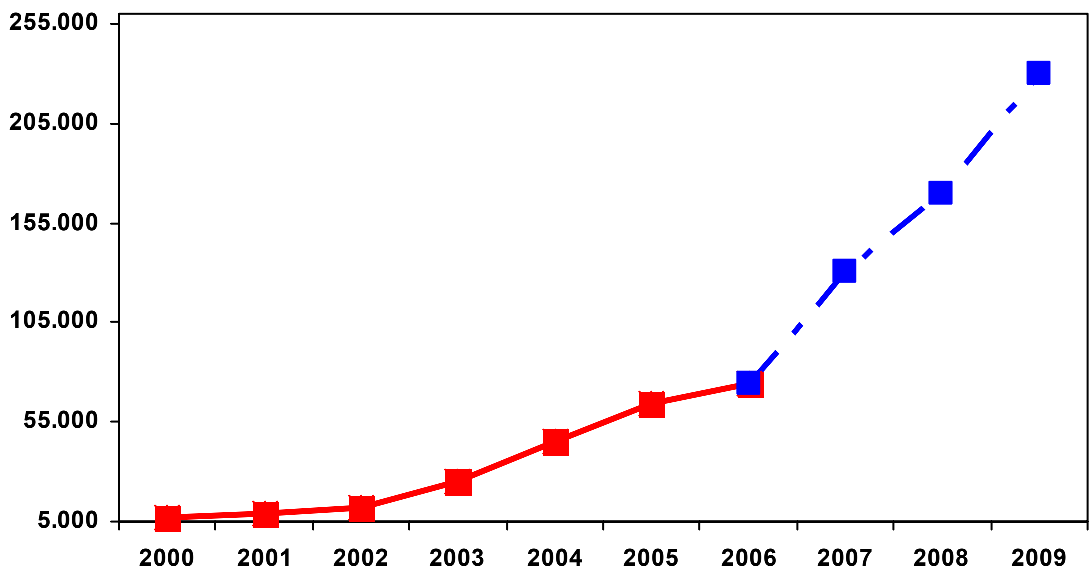

Figure 6. Production Output

Increases in production were achieved by investment in new equipment, de bottlenecking, introduction of Western management and process streamlining, this enabled the out put to be increased from 6,000 tonnes in 2001 to 82,000 tonnes in 2006.
It became obvious to the senior management in 2004 that with the continued success more production would soon be required and a second facility was commissioned, design and built.

Figure 7. DMR – Dalian Mayerton Refractories

The new production facility in Dalian was commissioned at the end of 2006 as part of a three phase expansion program. The facility has state of the art computer control in all areas and has been constructed to allow for the planned expansion.

Phase 1 – an initial out put of 80,000 tonnes of magnesia carbon bricks
Phase 2 – increase in magnesia carbon out put to 150,000 tonnes
Production of Monolithics, Alumina Castables and pre cast shapes
Phase 3 – increase in out put of magnesia carbon bricks to 300,000 tonnes
That concludes my presentation on a success story from China.