

*ICDA Paris Meeting
12-13 November 1998*



Life beyond ferrochrome

**A review of chromite ore supply
plus a focus on special grades**

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Editor, Industrial Minerals**

Industrial Minerals Information Ltd



- a subsidiary of Metal Bulletin PLC, UK
- providing a premium service to the global non-metallic minerals industry
- journals, newsletters, books, directories, conferences, consultancy, internet

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- Last week: absorbent clays for cat litter
- Next week: fused silica for semiconductors
- This week:

Chromite

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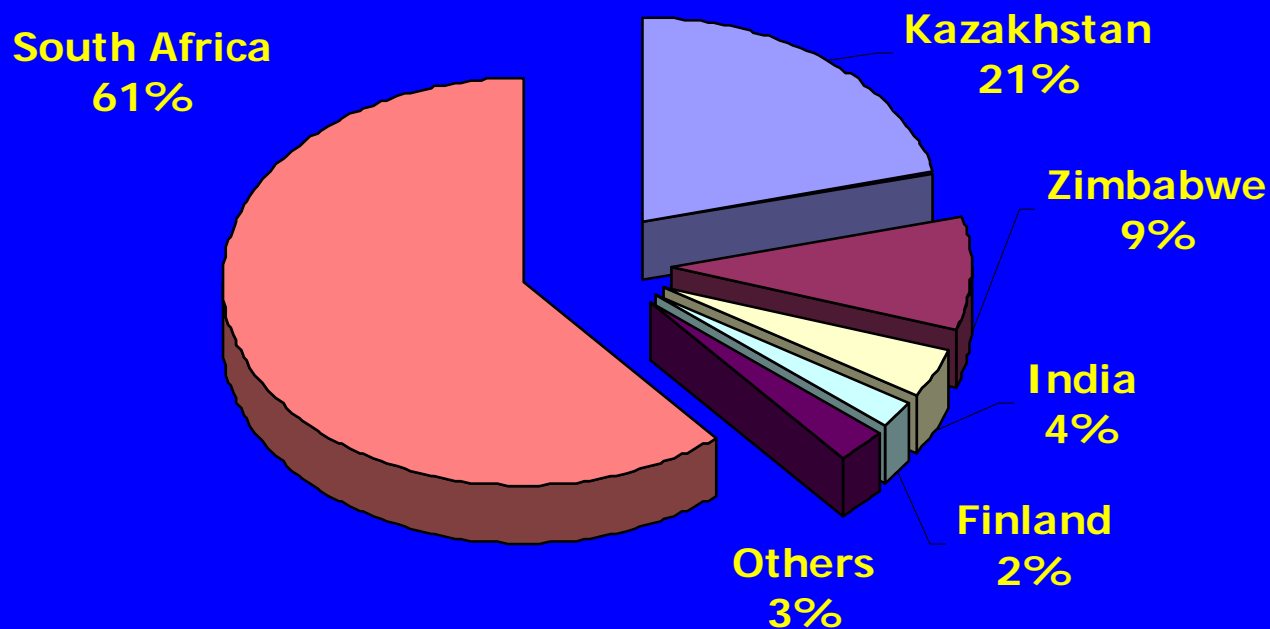
Life beyond ferrochrome

1. Overview of chromite ore supply
2. Focus on special grades

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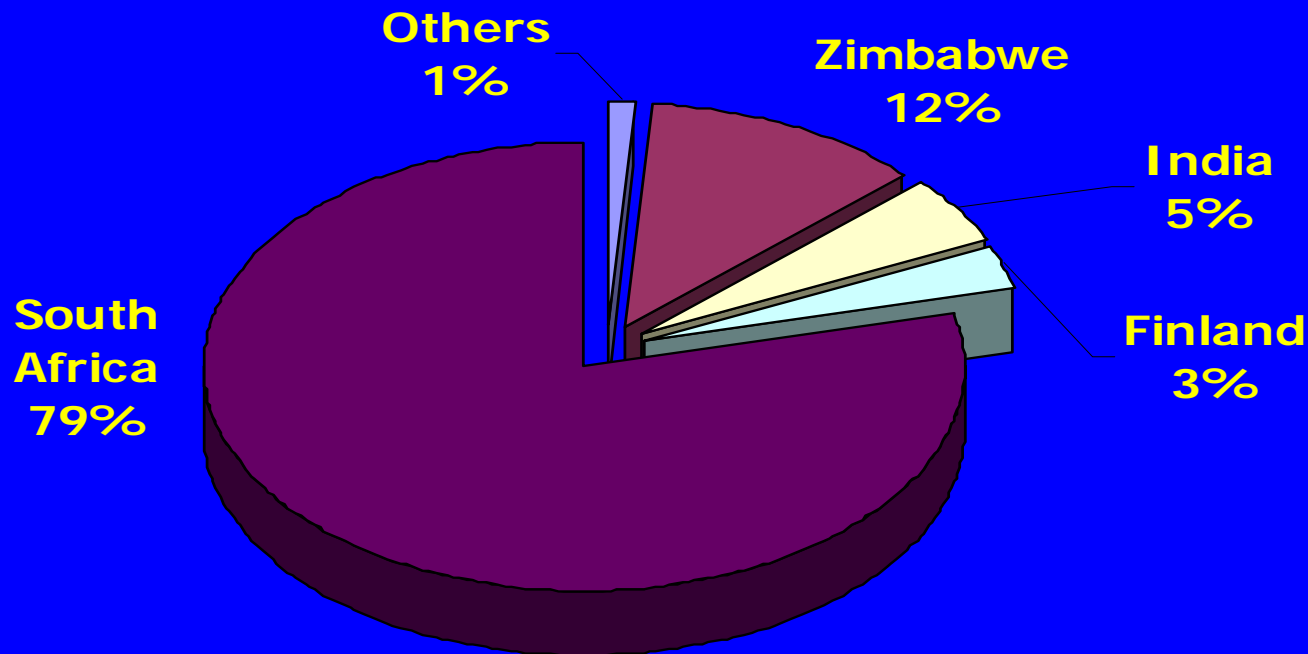
World chromite reserves distribution 482m. tonnes Cr



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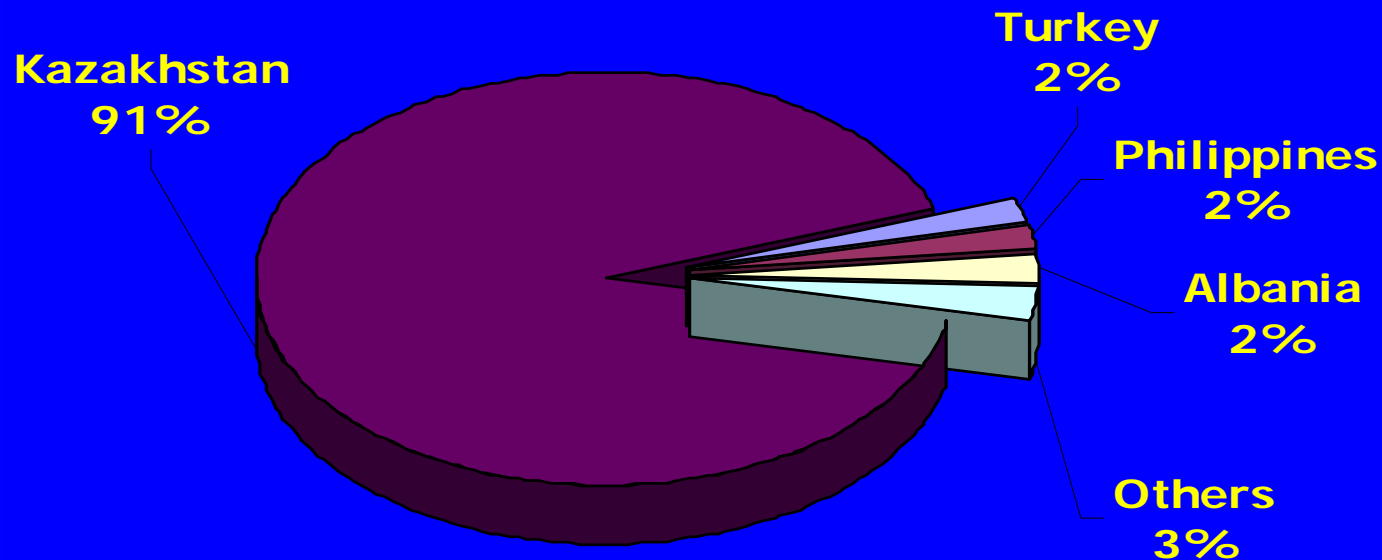
World chromite deposits - stratiform



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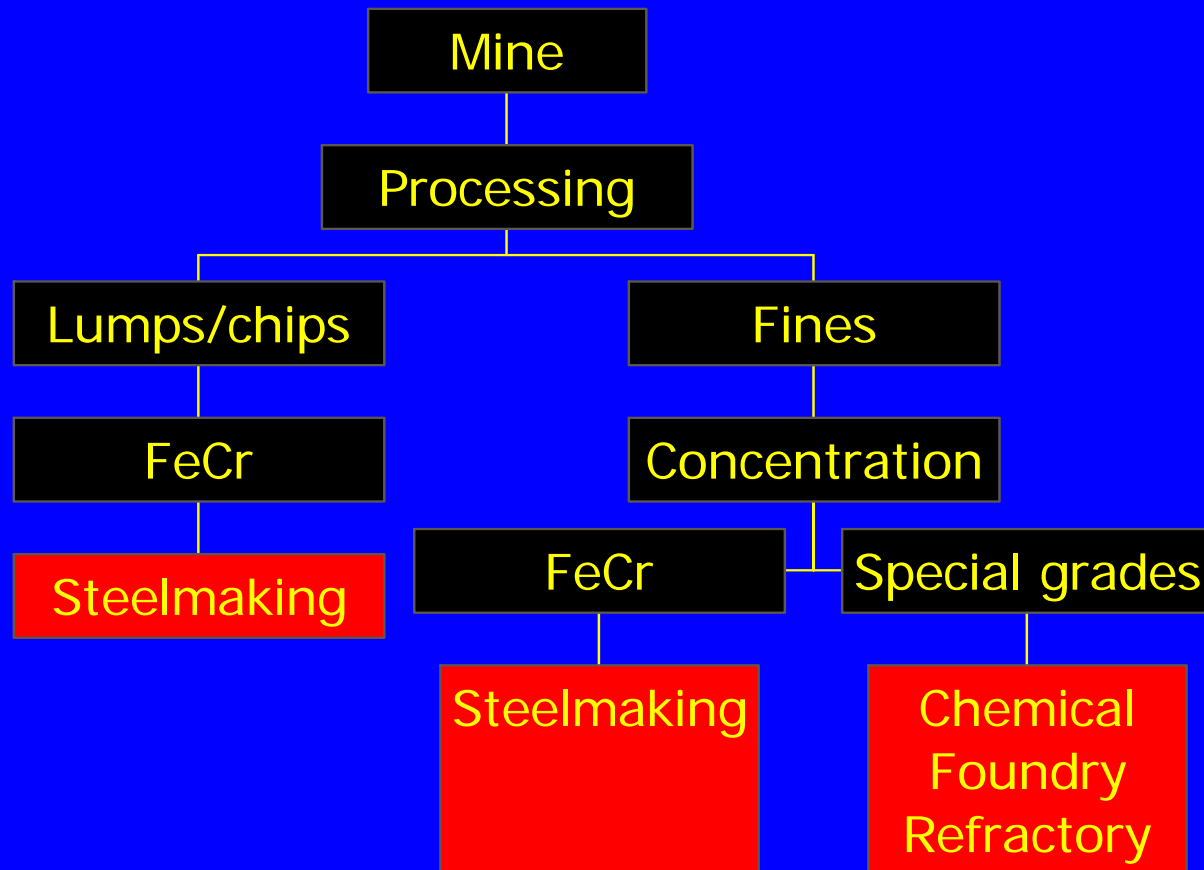
World chromite deposits - podiform



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Chromite ore: the route from mine to market



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Trends & developments in chromite ore supply

- Cyclical & follows FeCr supply and demand
- Special grades demand has minimal impact
- SA dominant
- SA output rise, FeCr integration, ownership changes
- Problems in Kazakhstan & Albania
- Trade mainly to Europe & Asia

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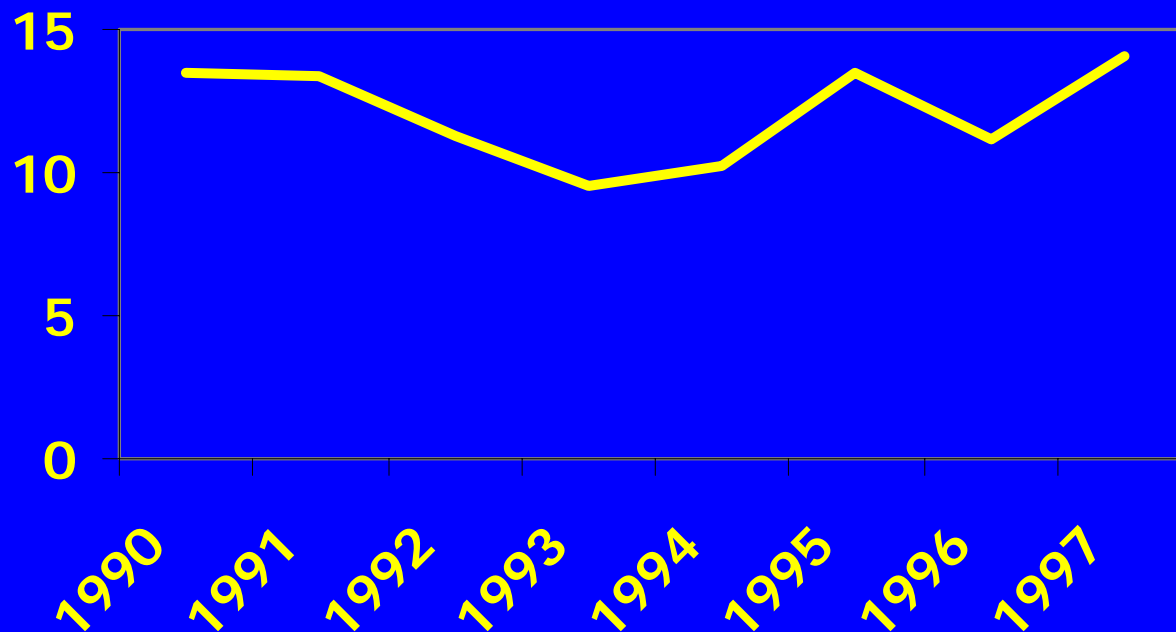
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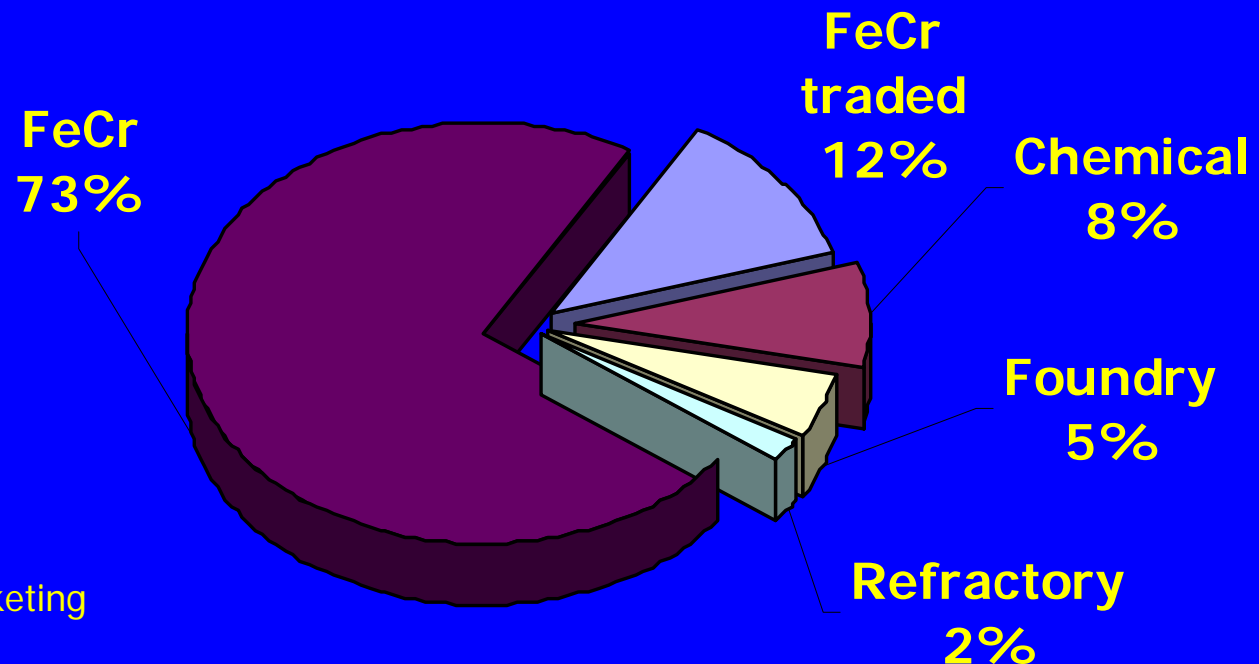
Production of chromite 1990-97 (m. tonnes)



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Chromite ore demand 1997 12.8m. tonnes

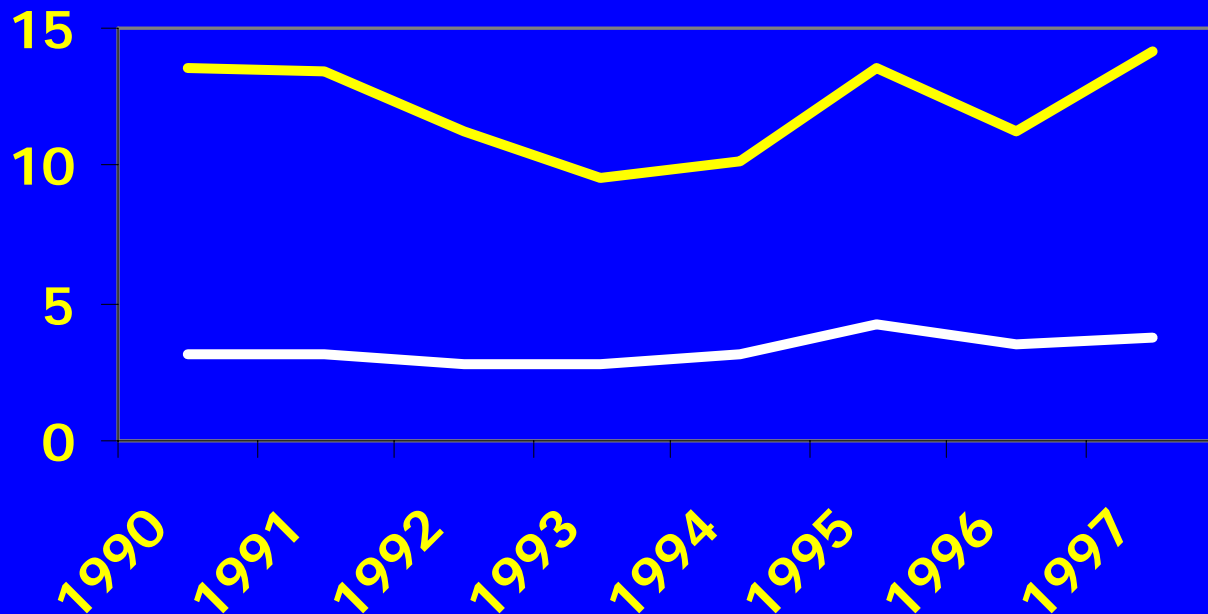


Source: FAH Marketing

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FeCr the driving force
Chromite & ferrochrome production
1990-97 (m. tonnes)



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FeCr outlook

**Stainless steel demand
4-5% growth to 2010**



**FeCr production capacity rise
4m. to 7m. tpa by 2010**



Increased demand for chromite ore



**Chromite ore production capacity rise
11m. to 21m. tpa met. Cr**

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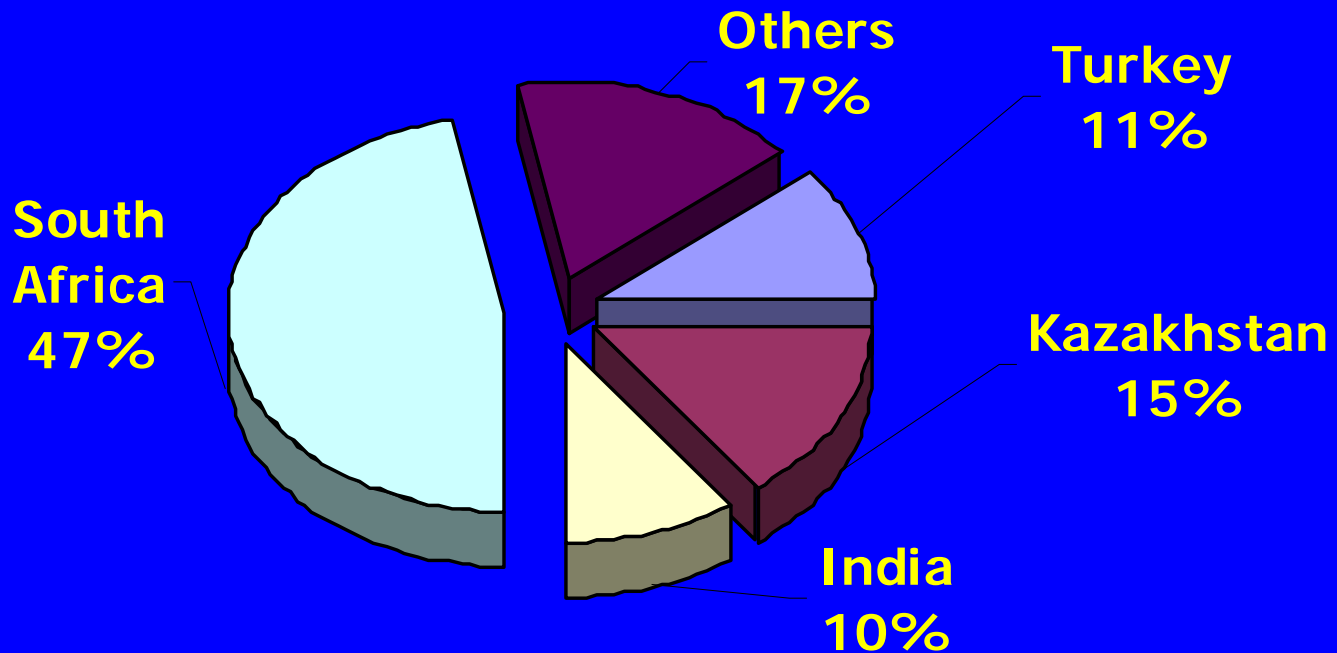
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Chromite ore production 14.1 m. tonnes 1997



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Leading chromite producers 1997

South Africa	6.672 m. tonnes
Kazakhstan	2.076
India	1.363
Turkey	1.593

Zimbabwe	0.640
Finland	0.588
Brazil	0.285
Iran	0.168
Albania	0.158
Madagascar	0.139

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South Africa - integration, expansion corporate change

- world dominance; 55% FeCr production
- Cr ore capacity & output increase
- dominance of "big two"
 - Samancor
 - Südelektra (CR/CMI)
- 8 major players; "fly by night" operators?
- FeCr integration: 80% Cr ore production
- increased use of fines in FeCr production
- Chrome Chemicals exception

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Kazakhstan/Albania

- **Kazakhstan**
 - **KMRC vs TWG dispute smoulders on**
 - **little or no impact on output**

- **Albania**
 - **industry struggling**
 - **UK/Italian consortium**

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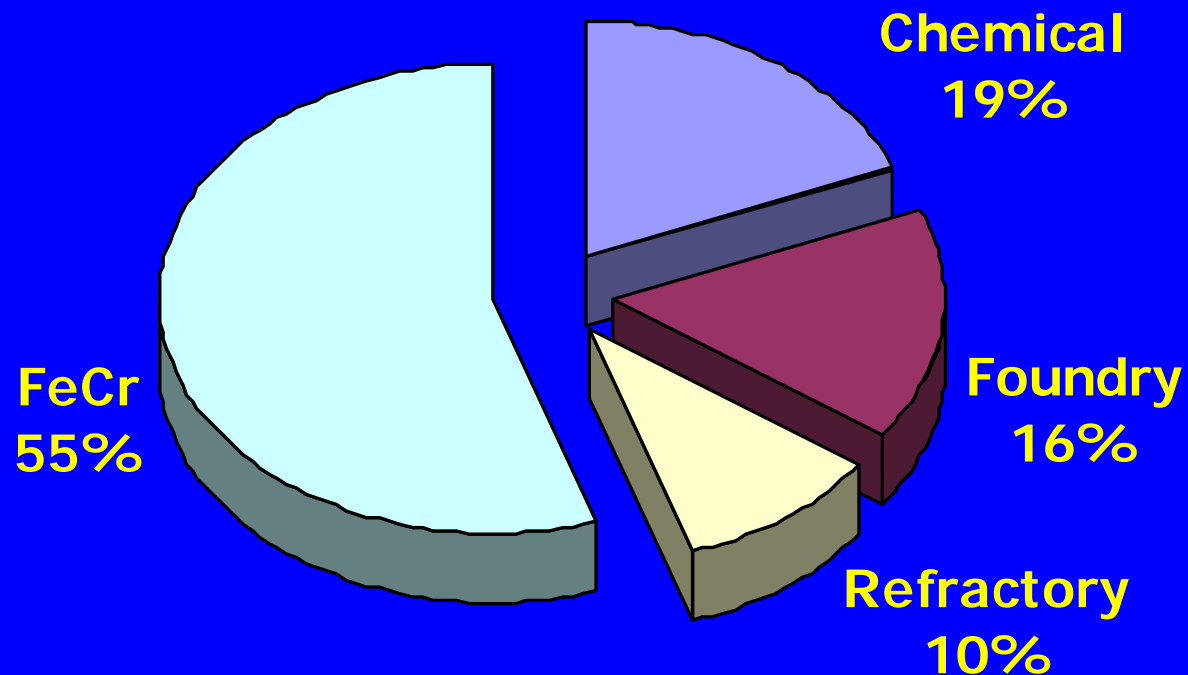
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Traded chromite ore consumption 3.2m. tonnes 1997



Source: FAH Marketing

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Chromite trade to Europe 1997

(tonnes)

<i>Western Europe</i>		<i>Eastern Europe</i>	
South Africa	503,537	Kazakhstan	510,987
Turkey	63,732	Turkey	164,753
Philippines	13,833	Albania	44,450
Albania	6,480	South Africa	13,324
Total	1,277,370	Total	778,272

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Chromite trade to Asia & Americas 1997 (tonnes)

Asia

South Africa 523,635

India 476,951

Iran 164,579

Turkey 83,693

Pakistan 51,189

Philippines 47,435

Americas

South Africa 359,578

Philippines 24,656

Total 398,291

Total Asia 1,491,667

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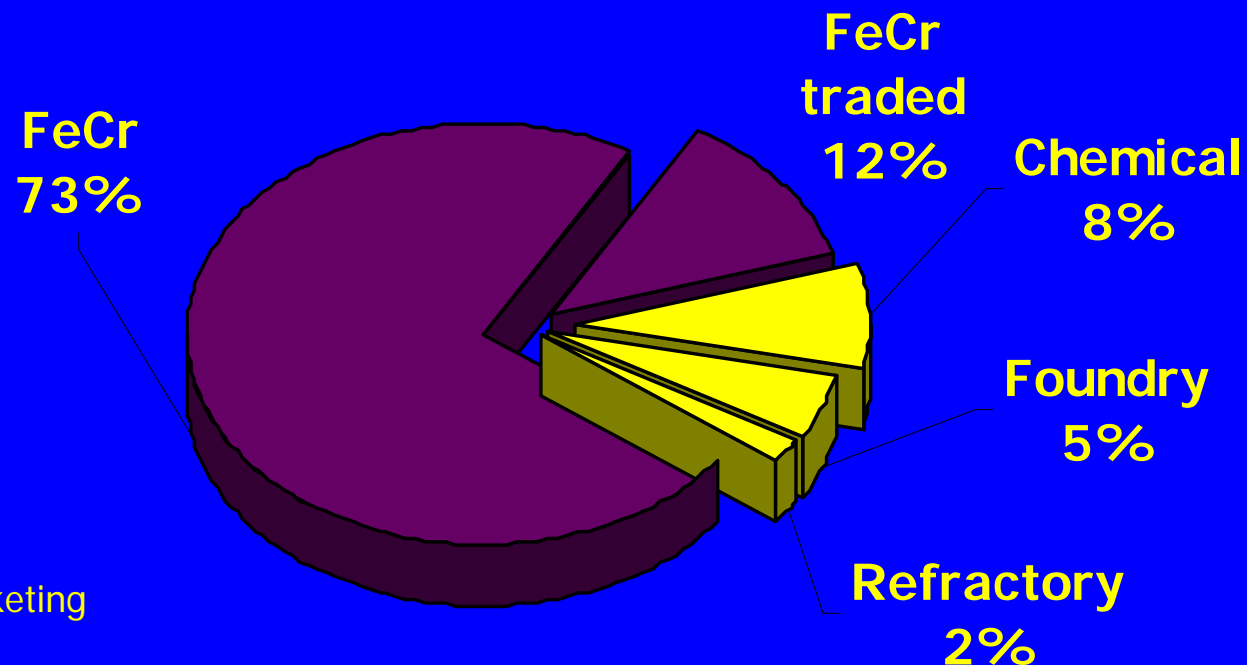
Special grades focus

- **Chemical**
- **Foundry**
- **Refractory**

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Chromite ore demand 1997 12.8m. tonnes



Source: FAH Marketing

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Special grades focus - chemical

- sodium dichromate & various Cr chemicals
- plating, pigments, leather tanning, timber preservation
- Cr:Fe not priority, low often preferred
- 40-45% Cr_2O_3
- friable ore, low SiO_2 (1%), MgO (9-11.5%)

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Special grades focus - foundry

- **specialist sand in metal casting**
- **manganese, carbon, alloy steels**
- **low thermal expansion coefficient, superior heat conducting properties**
- **angular grain shape, strict PSD, AFS 45-55**
- **min. 44% Cr₂O₃, max. 26% Fe₂O₃, <1.0% silica**
- **low acid demand**

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Special grades focus - refractory

- historically used in MgO-Cr₂O₃ refractory bricks in steel, cement, glass, non-ferrous metals
- co-sintered and fused MgO-Cr₂O₃
- excellent refractoriness, spalling resistance, good mechanical strength at high temperatures
- Cr₂O₃ + Al₂O₃ = >57% refractory grade, <1.0-3% SiO₂
- coarse grain size, AFS 30-40

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Special grades focus

supply trends

Western world production

Chemical 850,000 tonnes

Refractory 400,000

Foundry 250,000

_____ Total 1,500,000

World production

Total +/- 2m. tonnes

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Special grades focus supply trends

Major producers

South Africa

Philippines

India

Kazakhstan

Turkey

Pakistan

UAE

Oman

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Special grades focus supply trends

Major producers

South Africa

- 1.1-1.4m. tpa
- 55-60% exports
- low Cr:Fe
- greater use of fines
- integrated FeCr

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Special grades focus - supply trends
South African non-met. prod. cap. estimates

Buffelsfontein Chrome	18,000 tonnes
Chrome Chemicals	300,000
Chrome Resources	60,000
CMI	100,000
	(225,000 98/99?)
Dilokong Chrome	68,000
Hernic	100,000
Marico-Chrome	10,000
Samancor	510,000
Total	1,166,000
	1,400,000 98/99?

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Special grades focus - supply trends

Major producers

- | | |
|--------------|------------------------|
| South Africa | - 55% exports |
| Philippines | - sharp decline |
| India, Iran | - mainly domestic |
| Kazakhstan | - mainly CIS |
| Turkey | } limited volumes |
| Pakistan | } of refractory |
| UAE | } grades |
| Oman | } |
| Finland | - ceased foundry grade |

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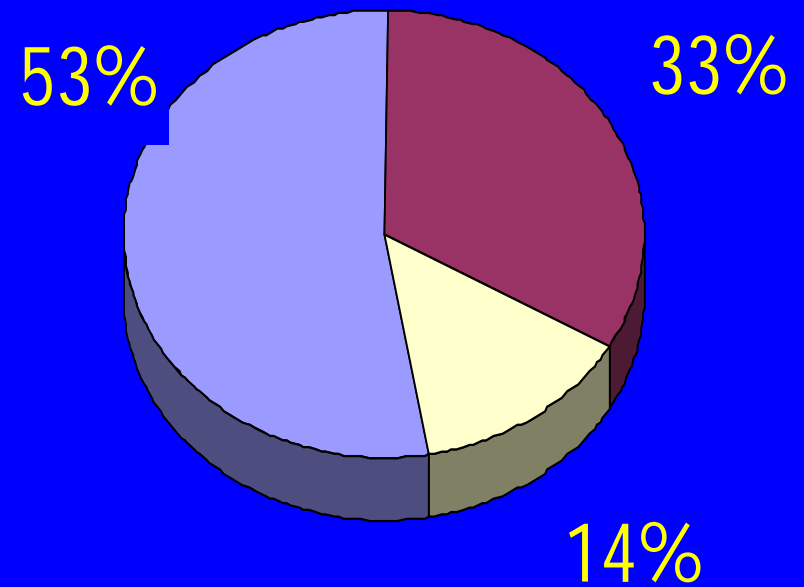
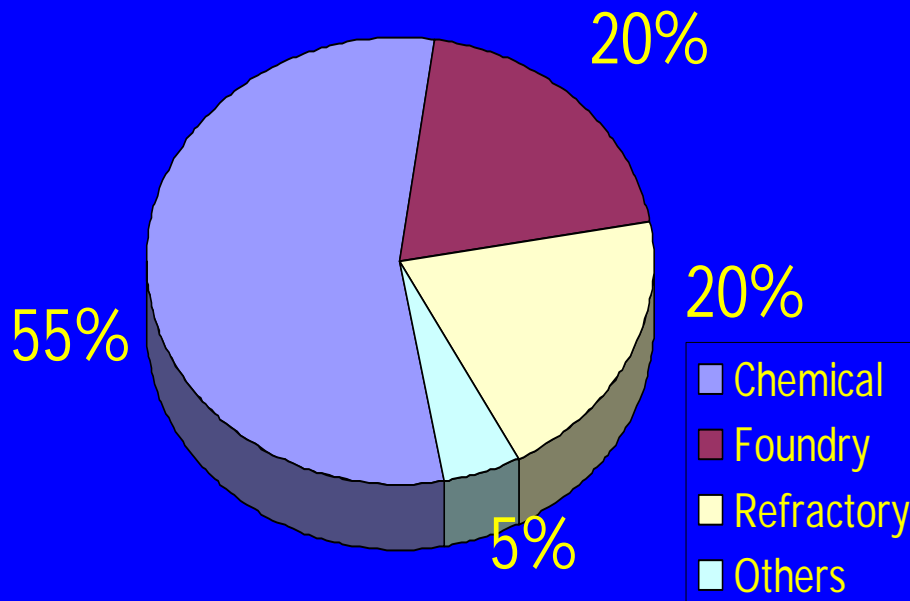
Increased "availability" of special grades?

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Special grades focus markets trends

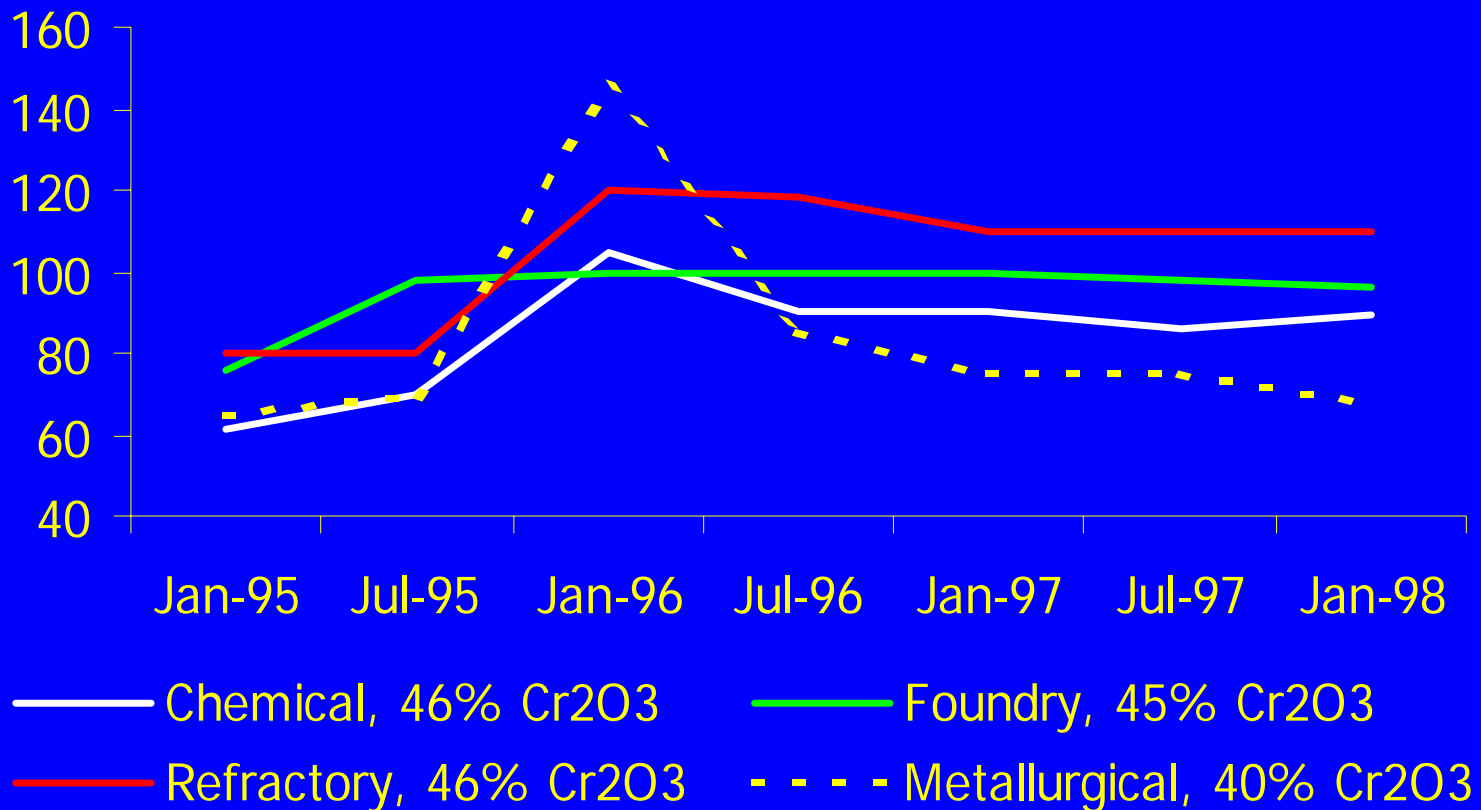
Non-met. market 1.8-2m. tonnes



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Transvaal chromite ore prices 1995-98 US\$/tonne



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Special grades focus
markets trends
Current prices

Transvaal, wet bulk, FOB US\$/tonne

Chemical	75-85
Foundry	82-92
Refractory	100-120
Metallurgical	63-68

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Special grades focus markets trends

- **Overall market** - shrunk from 5m. 1990 to 2m. tonnes in 1998
- **Chemical**
 - growth of 1-2%
 - Bayer shifts to SA
- **Foundry** - stable
- **Refractory**
 - declining
 - Cr⁺⁶ hazard
 - niche applications

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Conclusions

- SA is the primary supplier of chromite for all grades
- smaller players serve low volume special grade market niches
- special grade markets exert little or no impact on chromite production
- FeCr demand rise = SA Cr ore production rise = “potential capacity” rise for special grades
- met. Cr demand effect on special grade demand/prices
- special grade market growth limited

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Life beyond ferrochrome?

A. Nice work if you can get it

**B. There is life, but perhaps not
as lively as we would wish it!**

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