



PROGRAM : SSA NATIONAL DIPLOMA
ENGINEERING METALLURGY

SUBJECT : PRODUCTION OF IRON AND STEEL 4

CODE : PRS42-2

DATE : SUMMER SSA EXAMINATION 2015
7 DECEMBER 2015

DURATION : (SESSION 1) 08:00 - 11:00

WEIGHT : 40 : 60

TOTAL MARKS : 100

EXAMINER : DR X PAN

MODERATOR : M HENDERSON

NUMBER OF PAGES : 3 PAGES

INSTRUCTIONS : ANSWER ALL QUESTIONS

REQUIREMENTS : CALCULATOR

QUESTION 1 (30 marks)

In South Africa various production processes are used to produce charge chrome, such as Outokumpu process, Premus process, conventional SAF process and DC plasma furnace process. Use I-P-O process model to answer the following questions:

1. Draw the process flow-sheet of conventional SAF process (10 marks)
2. Draw the process flow-sheet of DC plasma process (10 marks)
3. Compare the two processes above with 5 main differences (10 marks)

[30]

QUESTION 2 (70 marks)

Xstrata is one of the main producers of charge chrome in the world. At its Lion Plant, the No 4 furnace has behaved irregularly in the last 2 days since the change of some raw materials, such as high roof temperature and difficult to tap. It is required urgently to find out what are the main causes and bring the furnace back to normal production. As a part of the cause-finding process, you are given the following tasks:

- (1) Calculate the mass balance of the furnace in the period of last 2 days, find out any abnormal issues and propose your solutions (30 marks)
- (2) Calculate the mass balance in each zone, using the 5-zone smelting model by Dr X Pan, (40 marks)

Attached the details of various raw materials charged to the furnace in the last 2 days with production of 14 092 kg of ferrochrome:

33 353 kg ore
6 988 kg quartzite
5 948 kg coke

Attached also find the chemical compositions of materials/products of the furnace and the phase diagram of $\text{SiO}_2\text{-MgO-Al}_2\text{O}_3$.

Table 1. Raw material composition

Name, %	Cr ₂ O ₃	Fe ₂ O ₃	FeO	MgO	SiO ₂	Al ₂ O ₃	H ₂ O	C
Ore	39	8	15	10	9	14	5	0
Quartzite	0	0	0	0	100	0	0	0
Coke	0	0	0	0	7	4	0	89

Table 2. Alloy and slag composition

Name, %	Cr ₂ O ₃	FeO	MgO	SiO ₂	Al ₂ O ₃	Cr	Fe	C	Si
Slag	?	?	?	?	?	0	0	0	0
Alloy	0	0	0	0	0	52.87	35.02	7.51	4.59

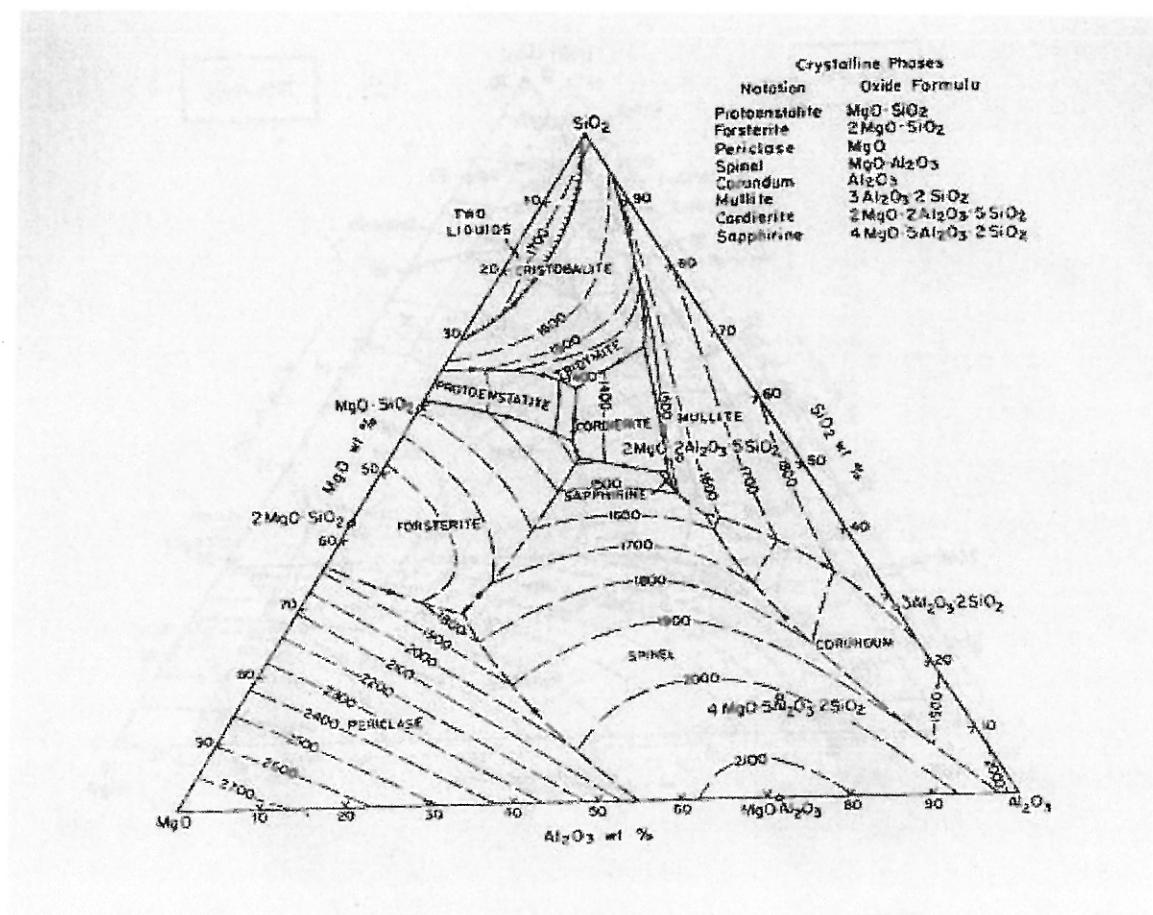


Figure 1. Phase diagram of SiO₂-MgO-Al₂O₃

Table 3. Atomic weight

Element	Fe	Cr	Si	Al	Mg	O	C	H
Weight	56	52	28	27	24	16	12	1

[70]

Total = 100