UNIVERSITY OF TORONTO
FACULTY OF APPLIED SCIENCE AND ENGINEERING

FINAL EXAMINATIONS, APRIL 2001
FOURTH YEAR – PROGRAMS 8 AND 9

MMS 502S – METAL PROCESSING AND THE ENVIRONMENT
(FRIDAY APRIL 20, 2001)

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ANSWER FIVE QUESTIONS
ALL QUESTIONS ARE OF EQUAL VALUE

Marks

6 1. Outline the treatment and abatement technologies currently used in conjunction with the By-Product Process for cokemaking.

The details of the operation of a by-product coke-oven plant are presented in the table below. The amount of tar recovered per ton of coal used was 40.0 kg.

14 Calculate, per ton of coal charged,

(a) the weight of coke produced
(b) the volume of gas made, dry basis (using a carbon balance)
(c) the fractions of the total sulfur that are present in coke and gas, and
(d) the quantity of air in kg that leaked into the coke oven (using a nitrogen balance)

Assume that the air is dry and consists of 79% N_2 and 21% O_2.

Table – Compositions of the Various Materials

Coal (wt.%)		Coke (wt.%)		Tar (wt.%)		Gas (dry analysis) (Vol. %)	
C	75.9	C	85.1	C	89.3	C_6H_6	1.1
H	4.7	H	1.8	H	4.6	C_2H_4	2.8
N	2.4	O	2.3	N	1.1	CH_4	34.3
S	1.8	N	0.8			CO	11.8
O	2.5	S	1.1			CO_2	1.2
H_2O	6.3	Ash	8.9			H_2	35.7
Ash	6.4					N_2	6.8
						O_2	2.9
						H_2S	2.0
						NH_3	1.4

Marks

20 2. Give an overview of the environmental concerns raised by the process route currently employed in integrated iron and steel making, and a critical appraisal of the relative severity of these. Indicate the six ways in which these concerns are being handled, and discuss ONE of them in reasonable detail.

20 3. Discuss the environmental arguments for and against the replacement of steel in automobiles by lighter metals such as aluminum or magnesium, taking into account the environmental implications of producing each of these metals.

8 4. (a) Define life-cycle assessment (or analysis). Indicate the four stages involved and elaborate briefly on two of these.

12 (b) Using a beverage container as a simple example, outline the results of such an analysis, comparing steel, aluminum and HDPE.

20 5. A zinc refinery plant in Canada treats 25 tons/hour sulphide concentrate. Suggest a flowsheet to recover zinc and the steps needed to operate under a "zero effluent discharge" guideline.

20 6. A mining company in Chile plans to develop a copper oxide ore body containing 0.3% Cu to recover contained copper using a hydro metallurgical process. Discuss different flowsheet options to recover the contained copper values.

20 7. A North American recycler plans to collect and process 25,000 ton/year of spent catalyst. Discuss business issues, including process options, to recover V, Mo, Co and Ni for a sustainable operation.