PRINCE OF SONGKLA UNIVERSITY
FACULTY OF ENGINEERING

Final Examination: Semester II — Academic Year: 2008

Date: February 21, 2009 — Time: 09:00-12:00

Subject: 230-544 Air Pollution Control Technology for Gaseous and Particulate Emissions — Room: A400

อนุญาตให้นำเอกสารและเครื่องคำนวณทุกชนิดเข้าห้องสอบได้
ทุจริตในการสอบโทษขั้นต่ำคือปรับตกในรายวิชาที่ทุจริต
และพักการศึกษา 1 ภาคการศึกษา

Name _____ Student No. _____

Please do all 8 questions. Show all your work to receive full or partial credit. Final score is 100. (Total page = 11, including first page)

Question #	Total Score	Score
1	10	
2	20	
3	10	
4	10	
5	10	
6	10	
7	20	
8	10	
Total	100	

Asst. Prof. Chayanoot Sangwichien

14 February 2009

1. (10 points) Please answer all this questions.

a) What is Opacity?

b) What is the definition of PM_{10} defined by U.S.EPA?

c) What is total suspended particulate matter?

d) What are ultra fine particles?

e) Calculate the aerodynamic diameter of a spherical particle having a physical diameter of 3 μm and a density of 4.2 gm/cm^3.

2. (20 points): Read each question and choose the best answer. Write the letter of your answer in the space provided.

2.1 What type of electrostatic precipitator that does not require rappers or liquid distributors.

a. Dry, negative corona
b. Wet negative corona
c. Wet positive corona
d. Answers b and c

2.1 _____

2.2 Dust layer resistivity in what conditions that can make dry negative corona precipitators operate best?

a. High resistivity
b. Moderate resistivity
c. Low resistivity
d. No resistivity

2.2 _____

2.3 What type of electrostatic precipitator is used to collect organic mists?

a. Dry, negative corona
b. Wet negative corona
c. Wet positive corona
d. Answers b and c

2.3 _____

2.4 The secondary voltage is _____.

a. The current applied on the discharge electrodes
b. The voltage applied to the primary side of the T-R set
c. The voltage applied by the back up power supply used in the event that the primary circuit trips offline
d. The voltage applied on the discharge electrodes

2.4 _____

2.5 What are the typical superficial gas velocities through a dry, negative corona precipitator?

a. 1-5 ft/sec
b. 3-6 ft/sec
c. 1-5 ft/min
d. 3-10 ft/sec

2.5 _____

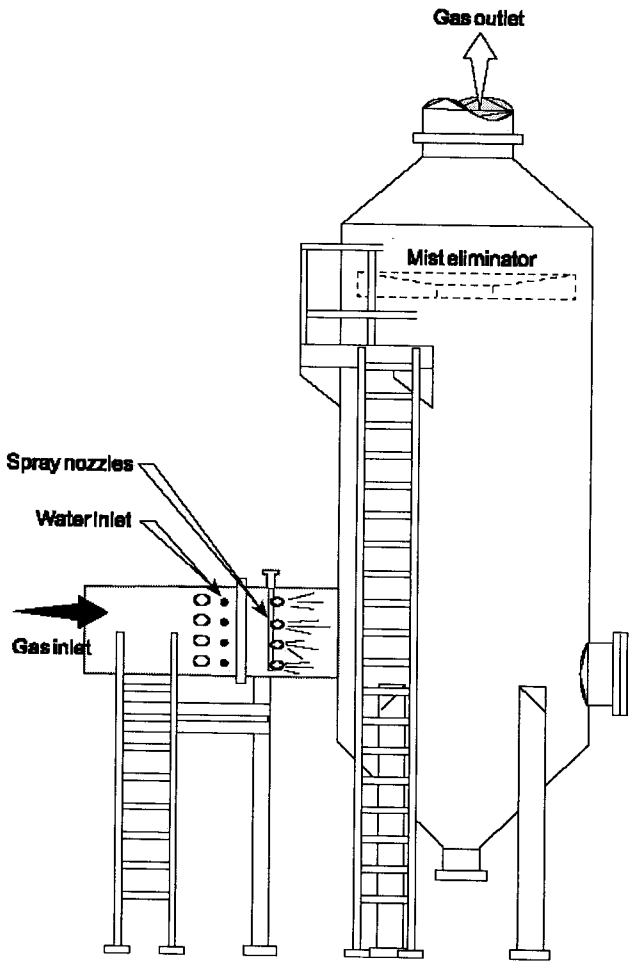
2.6 One electrostatic precipitator serving a coal-fired boiler has a gas stream of 600,000 ACFM, an inlet particulate mass concentration of 5 grains per ACF, and a specific collection area (SCA) of 400 ft^2/1000 ACFM. The unit has three fields **in series**. What is the increase in the emission rate if the outlet fields trips offline due to an internal mechanical-electrical problem?

Additional data: The inlet field has an efficiency of 85 %, the middle field has an efficiency of 80% and the outlet field has an efficiency of 70%.

3. (10 points) Spherical having the physical diameter of 10 μm is moving at 1 ft/sec. Assume a gas density of 0.001205 gm/cm^3 and viscosity of 1.81 x 10^{-4} gm/(cm.sec) at 20 °C . Using Cummingham slip correction (C_c)
   a) Calculate the terminal settling velocity
   b) Calculate the particle Reynolds number

4. (10 points) Calculate the gross and net air-to-cloth ratios for a cartridge baghouse with 5 compartments, 20 cartridges per compartment, a cartridge length of 3 ft, and a cartridge diameter of 7 inches. Use a pleat depth of 1.25 inches and a total of 32 pleats in the cartridge. Use an actual gas flow rate of 3,500 ft^3/min. Assume two compartments are out of service when calculating the net air-to-cloth ratio.

5. (10 points) Describe this device and explain its operating principle.



6. (10 points) What are the common types of spray nozzles used in particulate wet scrubbers and which one is the most frequently used and why?

7. (20 points) Define and explain the following terms:

a. gasket

b. pulse jet

c. fabric blinding

d. terminal settling velocity

e. secondary particulate matter

f. dust layer resistivity

g. a puff

h. impaction parameter

i. mist eliminator

j. rapper

8. (10 points) Using the mass distribution shown in Table 1, calculate the overall particulate matter collection efficiency for the cyclone operating in accordance with the conditions in Table 2.

Table 1

Particulate matter distribution	
Size range	**% of mass**
5 to 15	2
15 to <25	3
25 to <35	8
35 to <45	12
45 to <55	25
55 to <65	27
65 to <75	17
75 to <85	5
85 to <115	1
Total	100 %

Table 2

Efficiency estimates	
$[d_p]_i$,μm	**Efficiency, $[d_p]_i$**
10	19
20	51
30	62
40	71
50	80
60	83
70	89
80	92
100	98
Total	N/A