國立臺灣大學 114 學年度碩士班招生考試試題

※ 注意：請於試卷內之「非選擇題作答區」依序作答，並應註明作答之大題及小題題號。

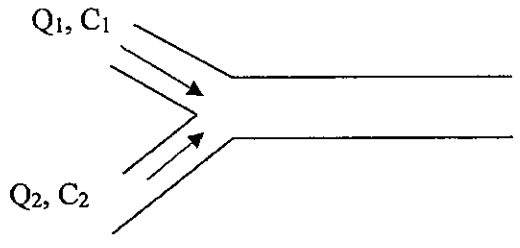
1. Please explain what Solid Recovered Fuel (SRF) is, including its primary sources and characteristics. Compare SRF with traditional fossil fuels in terms of carbon emissions, analyze whether SRF offers a carbon reduction advantage, and elaborate on the reasons behind this.
(15 pts)

2. A coal-fired power plant utilizes low-NOx burners to suppress the formation of nitrogen oxides during boiler combustion and employs selective catalytic reduction (SCR) equipment for NOx control. After combustion, the flue gas contains NOx at a concentration of 500 ppm (approximately 90% NO and 10% NO_2) with a flow rate of 50,000 m^3/min at 400°C and 1 atm. To meet stricter emission standards, the NOx concentration must be reduced to below 50 ppm. (1) Please explain the principles and reaction equations of SCR. (2) Assuming that the SCR removal efficiencies for NO and NO_2 are equal, please calculate the ammonia consumption required (kg/hr). (15 pts)

3. Activated carbon adsorption is a common technique for controlling VOC pollution. Please explain the significance of the breakthrough curve and describe the trend in its variation over operational time. (10 pts)

4. With the accelerated pace of modern life and increasing work pressures, dining out has gradually become a primary source of daily meals, driving the rapid development of the food and beverage industry, especially in urban areas. However, the prosperity of the restaurant industry also brings environmental challenges. During the cooking process, significant amounts of oil fumes are emitted, potentially polluting the surrounding air through exhaust duct and further threatening public health and urban air quality. Most restaurant operators commonly use wet scrubbers or electrostatic precipitators as equipment to manage oil fume emissions. Nevertheless, issues such as excessive fume emissions or odor dispersion persist. Based on the emission characteristics and aerosol composition of restaurant oil fumes, please explain why wet scrubbers or electrostatic precipitators (EPs) are insufficient in effectively controlling oil fume emissions.
(10 pts)

5. Two rivers with different flow rates (Q) and organic compound concentrations (C) merge as shown in the figure below. At the merging point, the water from the two rivers is completely mixed and travels downstream. Following information is known for the two rivers.



River 1: Q1 = $4x10^6$ m^3/d, C1 = 20 mg/L.
River 2: Q2 = $6x10^6$ m^3/d, C2 = 3 mg/L.
The organic compound can be degraded by bacteria in the river under aerobatic conditions. The degradation is a first-order reaction with a rate constant $k_d = 0.3$ d^{-1}. The cross-section area of the river after merging is 1000 m^2 and the longitude dispersion can be neglected.

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(a) Determine the organic compound concentration at the merging point. (5 points)
(b) It is known that the river water quality standard of the oragnic compound is 4 mg/L. Determine the location at downstream of the merging point where the river can meet the standard. (10 points)
(c) It is known that at the merging point, the dissolved oxygen (DO) is 9 mg/L which is the saturated DO level under the ambient temperature. Based on all information, draw a schematic diagram showing the DO level downstream of the merging point along the river and describe the processes causing the variations in your diagram. (10 points)

6. Risk assessment is a science focusing on relating adverse response to dose. Answer the following questions:
(a) Define "threshold" and "reference dose". Describe their roles in risk assessment (10 points)
(b) Explain why extrapolation is required for animal tests used to determine the carcinogenic effects (5 points)
(c) A worker (70 kg) is working in a plant that manufactures benzene. It is known that the air in his working place contains 0.0001 mg/m^3 of benzene and the worker inhales 20 m^3/day of air during his work. He decides to quit the job after 10 years of service. What is the incremental lifetime (70 years) cancer risk posed on this worker due to this job? Comment on whether this is an acceptable risk. (10 points)

Toxicity Data for Selected Potential Carcinogens

Chemical	Category	Potency Factor Oral Route $(mg/kg\text{-}day)^{-1}$	Potency Factor Inhalation Route $(mg/kg\text{-}day)^{-1}$
Arsenic	A	1.75	50
Benzene	A	2.9×10^{-2}	2.9×10^{-2}
Benzol(a)pyrene	B2	11.5	6.11
Cadmium	B1	—	6.1
Carbon tetrachloride	B2	0.13	—
Chloroform	B2	6.1×10^{-3}	8.1×10^{-2}
Chromium VI	A	—	41
DDT	B2	0.34	—
1,1-Dichloroethylene	C	0.58	1.16
Dieldrin	B2	30	—
Heptachlor	B2	3.4	—
Hexachloroethane	C	1.4×10^{-2}	—
Methylene chloride	B2	7.5×10^{-3}	1.4×10^{-2}
Nickel and compounds	A	—	1.19
Polychlorinated biphenyls (PCBs)	B2	7.7	—
2,3,7,8-TCDD (dioxin)	B2	1.56×10^{5}	—
Tetrachloroethylene	B2	5.1×10^{-2}	$1.0 - 3.3 \times 10^{-3}$
1,1,1-Trichloroethane (1,1,1-TCA)	D	—	—
Trichloroethylene (TCE)	B2	1.1×10^{-2}	1.3×10^{-2}
Vinyl chloride	A	2.3	0.295

Source: U.S. EPA, www.epa.gov/iris.

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