

BITS, PILANI – DUBAI
SECOND SEMESTER 2009 – 2010
FINAL YEAR CHEMICAL ENGINEERING

Course Code: CHE C413

COMPREHENSIVE EXAM

Date: 26.05.10

Course Title: Process Plant Safety

Max Marks: 80

Duration : 3hr

(Closed Book)

Weightage: 40%

- 1.(a) Mention the role of industrial hygienist in any process industry. (2 m)
- (b) Classify the airborne contaminants and discuss any three in detail. (2 + (3×2) = 8m)
- 2.(a) Determine the 8hr TWA worker exposure if the worker is exposed to toluene vapors as follows; (4 m)

Duration of exposure (hr)	Measured Concentration (PPM)
2	110
2	330
4	90

- (b) Explain how the permissible noise level can be calculated from TLV-TWA values. (2 m)
- 3.(a) Discuss in detail about various types of PPE for skin and body protection. (6 m)
- (b) Explain how safety and the layout are linked for highly flammable liquids in any process plant. (2 m)
- 4.(a) Give reasons to perform air sampling. (3 m)
- 4.(b) Discuss briefly the following: (2 + 2 = 4m)
- (i) Single compound explosives
 - (ii) Binary explosives
- 5.(a) Suggest the parameters to detect a leak in an oil pipeline. (2 m)
- (b) Discuss in detail various factors need to be considered while choosing material of construction for any equipments in process industries. (8 m)

- 6.(a) Mention the factors which makes success or failure of HAZOP study. (4 m)
- 6.(b) Mention the factors should include any process operating manual. (4 m)
- 7.(a) Explain in detail about the parameters involved in the emergency information panel. (10 m)
- (b) Discuss correct extinguishing techniques for different types of fire for water based dry powder. (4 m)
- 8.(a) What are the causes of temperature deviations for any process/operations? (4 m)
- (b) Mention the safety audit benefits. (4 m)
- 9.(a) Discuss in detail about the flammability diagram. (4 m)
- (b) Discuss what went wrong in the Bhopal gas disaster which should include (5 m)
- (i) the materials involved (1 m)
 - (ii) root causes (2 m)
 - (iii) what precautions should be considered in future to avoid such incidents (2 m)

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TEST2

Date: 09.05.10

Course Title: Process Plant Safety

Max Marks: 20

Duration : 50 minutes

(Open Book)

Weightage: 20%

Note: only prescribed txt book and own handwritten notes are allowed

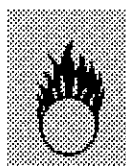
1. What is Hazard Identification Number and mention its significance. (4 m)
2. If the HIN is prefixed with an "X" this indicates the substance
_____ (1 m)

3. What is the meaning behind the following hazard warnings? (3 m)

a)



b)



c)



4. Tanks made from fiberglass-reinforced plastics are being increasingly used. But number of failures has occurred. Discuss any 3 catastrophic failures briefly. (3 m)
5. Paper mills use large quantities of water, and the water is usually recycled. Buffer storage is needed, and at one paper mill, it took the form of a 740-m³ tank. Experience showed that this was insufficient, and another tank of the same size was installed alongside. To simplify installation it was not connected in parallel with the original tank and process water was filled but was not connected to the process. A week later welders were about to complete the handrails on the roof. All of the sudden an explosion occurred. Two welders were killed, and the tank was blown 20 m into the air, landing on a nearby building.

What may be the reason behind this explosion and how can be avoided in future.(2 m)

6. Define off-site emergency plan. (2 m)
7. A hydrocarbon storage tank had to be gas-freed for entry. Air was blown into it with a fan. The vapor/air mixture in the tank had to pass through the explosive range. The fan impellor disintegrated and the resulting sparks ignited the vapor/air mixture. An explosion occurred.
Give recommendations to avoid such incidents. (2 m)
8. What are the hazards involved in the liquid and vapor phase oxidation process? (3 m)

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TEST1

Date: 28.03.10

Course Title: Process Plant Safety

Max Marks: 25

Duration : 50 minutes

(Closed Book)

Weightage: 25%

1. What is pigging? (2 m)
2. What is the difference between fumes and mist? (2 m)
3. Mention the substance producing health hazards from the following industries. (2 m)
a) Plastic industries b) Rubber industries
4. Discuss in detail about respirators (its types, characteristics and protects against). (5m)
5. What all the criteria need to be considered while siting and layout of a chemical plant? (5 m)
6. Mention the basic requirements for any sampling equipment. (3 m)
7. Discuss in detail about the characteristics of explosives. (4 m)
8. A plug valve was supplied stating that the valve was made from 304L steel (good resistant to nitric acid). The valve was installed in a nitric acid line and tightly closed. Five hours later the acid was escaping through the valve.
State the reason for the above incident and how to prevent in future? (1 + 1 m)

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Course Title: Process Plant Safety
Duration : 20 minutes

QUIZ 2
(Closed Book)

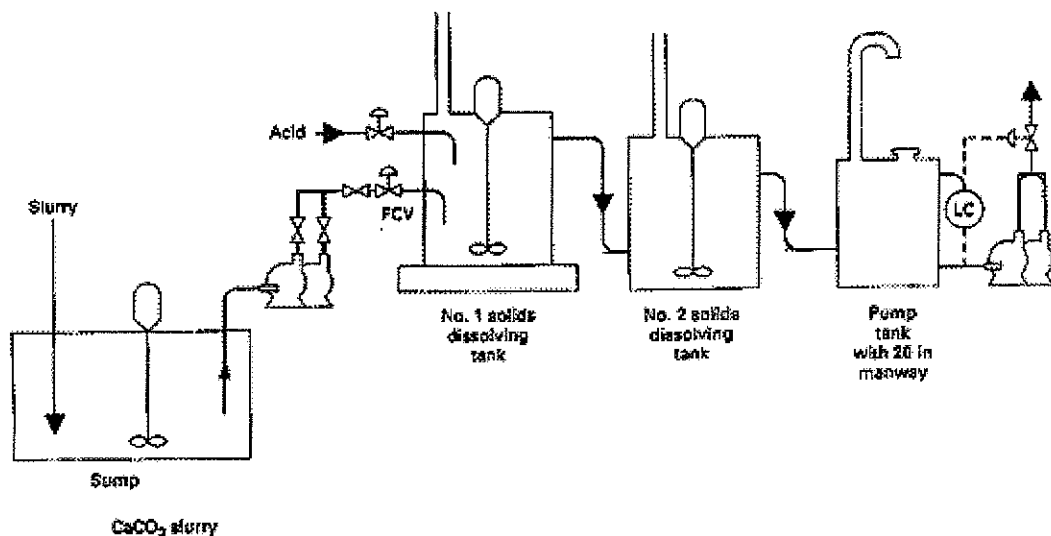
Date: 07.04.10
Max Marks: 08
Weightage: 8%

Name: ID No: Sec / Prog:

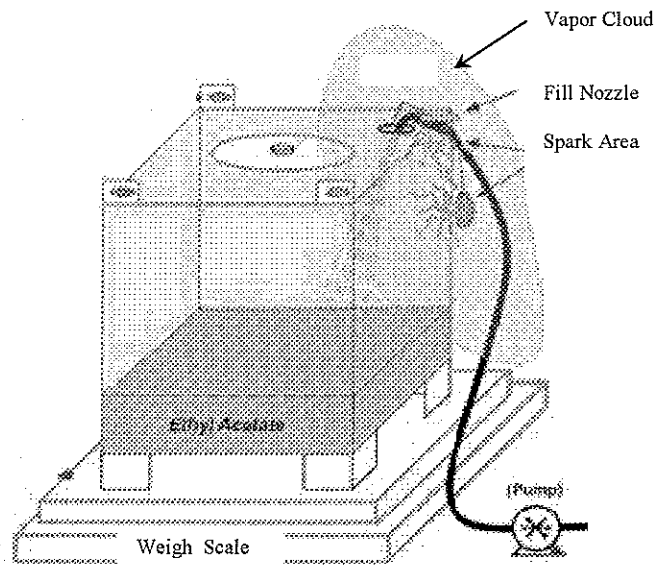
1. A chemical plant inorganic slurry solids were dissolved in a series of three fiberglass vessels. This process handled a relatively cool sodium chloride (table salt) water stream that was saturated with insoluble salts such as calcium carbonate and magnesium carbonate. The slurry contained about 30-percent calcium carbonate. Insoluble carbonates are treated with hydrochloric acid in two agitated vessels to allow a reaction to liberate carbon dioxide and form a soluble salt.

The dissolving system was scheduled for maintenance while the rest of the unit continued at full production rates. The chemical process operator was concerned about the available room in the sump as the slurry accumulated during the two- to three-hour outage. The operator drastically increased the slurry flow-rate into the dissolving system for about an hour before the shutdown. However, he only increased the flow of acid into the system slightly during that time. The basic process is shown in figure. The maintenance crew was scheduled to change the oil in the No. 2 Solids Dissolving Tank Agitator gearbox and to replace several slurry valves. To prepare for maintenance, operations shut down and tagged out the slurry pumps on the No. 2 Dissolving Tank agitator. Erroneously, the weak acid flow rate remained constant for about two hours, flowing into the No. 1 Dissolving Tank and overflowing into the No. 2 Solids Dissolving Tank.

After the maintenance was finished (it took two hours), an operator traveled up the stairs and restored the No. 2 Solids Dissolving Tank Agitator. Instantly, he heard a rumbling noise and a weak acid solution erupted from the No. 2 Solids Dissolving Tank, shooting up as high as 9 m in the air. This overpressure damaged two fiberglass tanks, and three nozzles cracked on the No. 2 Solids Dissolving Tank. Explain the reason behind the accident in the above process. (4m)



2. Give your recommendations by resketching the following figure for the safe operation of filling the ethyl acetate in a tank. (3 m)



FINAL YEAR

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