higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

CHEMICAL PLANT OPERATION N4

7 AUGUST 2019

This marking guideline consists of 6 pages.

Copyright reserved

QUESTION 1

1.1 False
1.2 False
1.3 True
1.4 False
1.5 True

(5 × 1) **[5]**

QUESTION 2

2.1 Assume the entrance level Z1 = 0
Volume of water is constant = $v_1 = v_2$
Velocity is constant throughout the pipe = $V_1 = V_2 = 0$✓

$\int pdV = 0$ (water is a noncompressible fluid)✓

$\sum F = Z_1g - Z_2g + P_1v_1 - P_2v_2 + W_o$
= (0 × 9,8✓) – (4,5 × 9,8)✓ + [(106 × 10 × 3✓) × 1/1 000]✓ – [(172,4 × 103)✓ × 1/1 000)] ✓ + 170,5✓
= 0 – 44,1 + 106 – 172,4 + 170,5
= 602 J/kg✓ (10)

2.2
- Streamline/Viscous/Laminar/Flow✓ flow of all fluid particles along the lines is parallel✓ to the axis of the pipe.✓
- Turbulent flow: ✓ course followed by individual particles of fluid deviates greatly from straight line✓ so that vortices and eddies are formed.✓

(3 × 2) (6)

2.3 2.3.1 Movement of materials✓ such as liquid, gases or dispersed solids through certain bounded regions.✓

2.3.2 Amount of mechanical energy necessary to balance output energy✓ against input energy in total mechanical energy balance✓

(2 × 2) (4)
[20]

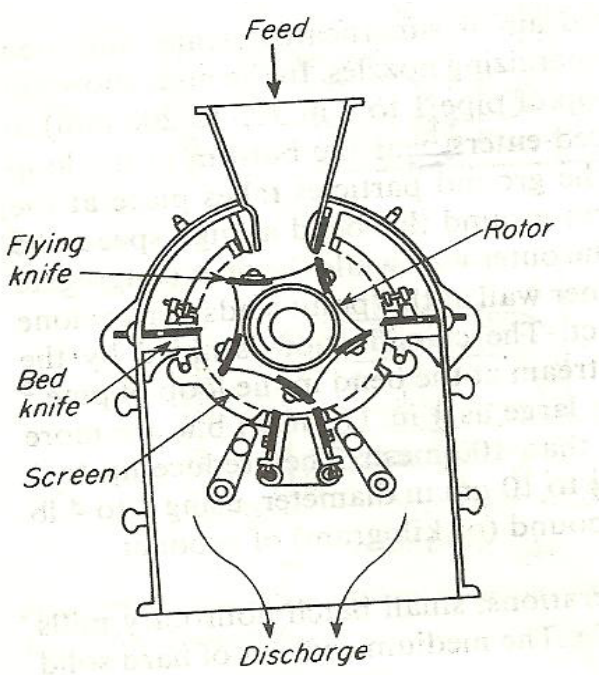
QUESTION 3

3.1 3.1.1
- Crushers break large pieces of solid materials✓ into small lumps.✓
- Grinders reduce crushed feed✓ into powder.✓ (2 × 2) (4)

3.1.2 Knife cutter (1)

3.1.3 Ultrafine grinder (1)

3.2



(6)

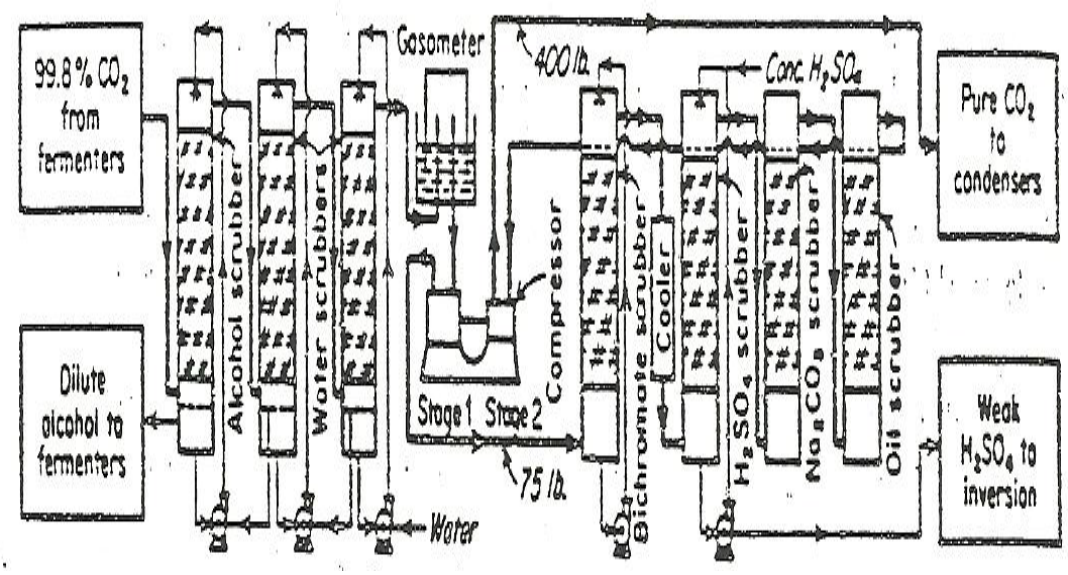
3.3
- A set of swing hammers is held between the two rotor disks.
- The rotor shaft carries two fans which draw air through the mill and discharge it into ducts leading to product collector.
- The rotor disks have short, radial vanes for separating oversize particles from acceptable sizes.
- In the grinding chamber the particles of solid are given a high rotational velocity.
- Coarse particles are concentrated along the wall of the chamber because of the centrifugal force acting on them.
- The air stream carries finer particles inwards from the grinding zone towards the shaft.
- The separator vane tends to throw the particles outwards.
- Acceptable fine particles are carried through; particles that are too large are thrown back for further reduction. (8)

[20]

QUESTION 4

4.1
- Electrolysis of water
- Steam reforming of hydrocarbons
- Thermal dissociation of natural gas
- Partial oxidation of hydrocarbons
- Reaction of acid and some metals (Any 3 × 1) (3)

4.2

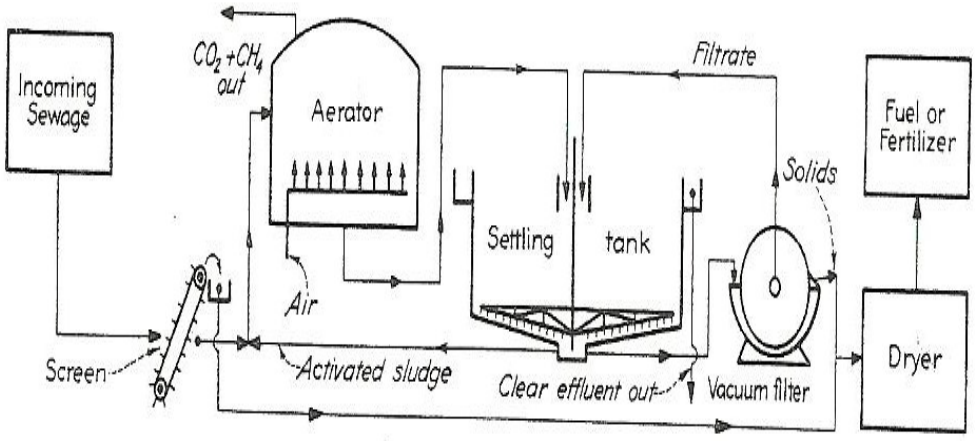


- The gas from the fermenters is passed through three scrubbers.
- The first scrubber contains a weak alcohol solution which acts as a preliminary purifier and removes most of the alcohol carried by the gas.
- The next two scrubbers use deaerated water as scrubbing medium and remove almost all the water-soluble impurities.
- From the gasometer the gas is conducted to a scrubber containing a $K_2Cr_2O_7$ solution which oxidises the aldehydes and alcohol.
- In the second scrubber which contains H_2SO_4, oxidation is completed and the gas is dehydrated.
- The acid is removed and an Na_2CO_3 solution is circulated.
- When the acid is neutralised, CO_2 is released.

(10 marks for any correct labelling
7 marks for the description) (17)
[20]

QUESTION 5

5.1



(8)

5.2
- Sodium cation exchange
- Hydrogen cation exchange
- Lime soda
- Phosphate conditioning
- Silica removal
- Desalting
- Demineralisation and distillation (Any 5 × 1) (5)

5.3 Process where some of the sludge removed from the settling tank✓ is mixed with oxygen or air✓ and partially-treated water✓ (3)

5.4 Tank that introduces air or oxygen✓ into the mixture of partially-treated waste water and activated sludge✓ (2)

5.5
- Methane (CH_4)
- Carbon dioxide (CO_2) (2)

[20]

QUESTION 6

6.1 Process whereby halogens are chemically reacted with hydrocarbons to form alkylhalides (3)

6.2 6.2.1 $CH_2 = CH_2 + HCl \rightarrow CH3 – CH2Cl$

6.2.2 $C_6H_6 + HCl + ½O \rightarrow C_6H_5Cl$✓ $+ H_2O$

(2 × 2) (4)

6.3
- Burns easily
- Readily dehydrated
- Shrinks badly
- Can be hydrolysed (4)

6.4
- Transparent
- Nonporous
- Virtually inert
- Hard and brittle (4)

[15]

TOTAL: 100

Copyright reserved