higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

CHEMICAL PLANT OPERATION N4

14 April 2020

This marking guideline consists of 5 pages.

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QUESTION 1

1.1 Absolute viscosity
1.2 Relative roughness
1.3 Sulphur dioxide
1.4 Fluid flow
1.5 Desalting or desalination

(5 × 1) **[5]**

QUESTION 2

2.1 D
2.2 G
2.3 E
2.4 A
2.5 C

(5 × 1) **[5]**

QUESTION 3

3.1 3.1.1 It represents the loss in mechanical energy✓ caused by frictional effects.✓ (2)

3.1.2 It is defined as the amount of mechanical energy✓ necessary to balance the output energy✓ against the input energy in a total mechanical energy balance.✓ (3)

3.2 $$Power = \frac{work\ done \times volume \times density}{time}$$

$$P = \frac{W_o \times V \times \rho}{t}$$

$$= \frac{425,6\ J/s✓ \times\ 0,189\ m^3 \times\ 721\ kg/m^3}{60\ s✓}✓$$

$$= 966,60\ J/s = W✓$$

$$Efficiency = \frac{966,60✓}{0,55✓}$$

$$= 1\,757,45\ W✓$$

$$Horse\ power = \frac{1\,757,45✓}{745,7✓}$$

$$= 2,357\ hp✓$$ (10)

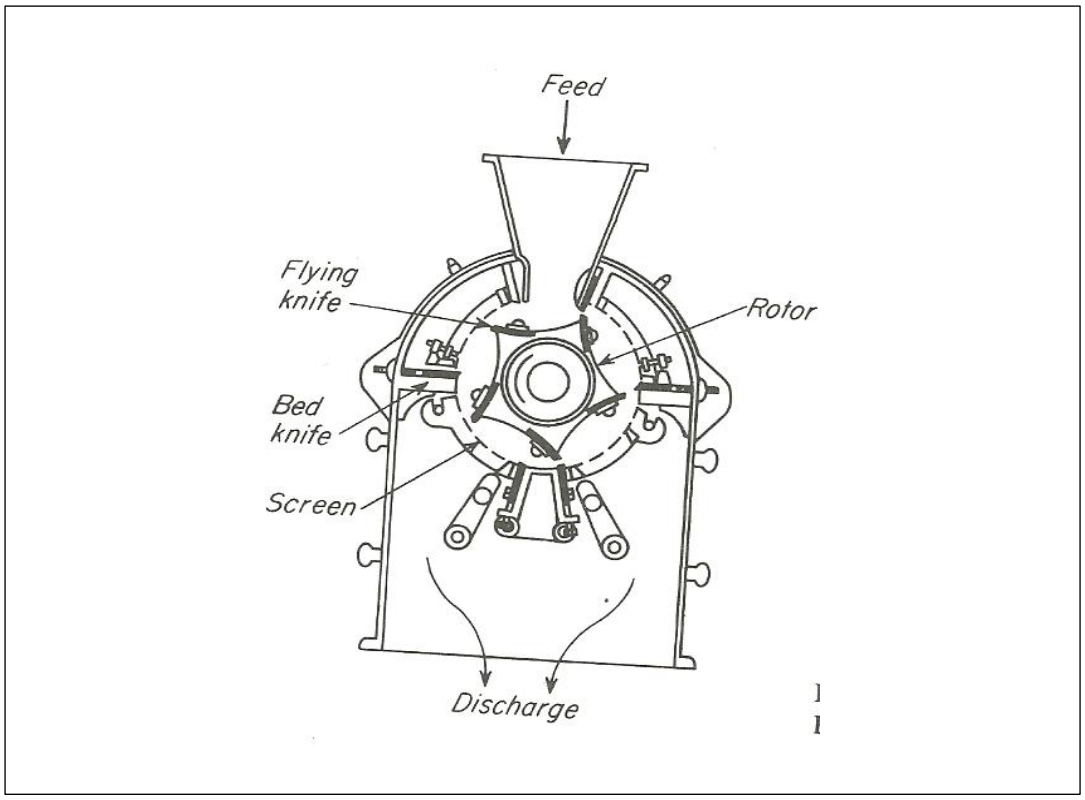
3.3 3.3.1 This is the numerical value of the dimensionless grouping✓ of the four variables✓ which serves to indicate whether the flow is streamline or turbulent.✓ (3)

3.3.2 This is the pressure measured on a plane perpendicular✓ to the direction of the fluid flow.✓ (2)

[20]

QUESTION 4

4.1



(ONE mark for each correct label) (6 × 1) (6)
(ONE mark for correct diagram) (1)

It contains a horizontal rotor✓ turning in a cylindrical chamber.✓ The rotor consists of flying knives with edges of tempered steel✓ or stellite passing with close clearance over stationary bed knives.✓ Feed enters from above are cut several hundred times per minute✓ and emerge at the bottom✓ through a screen with openings.✓ Sometimes the flying knives are paralleled with the bed knives,✓ sometimes depending on the properties of the feed they cut at an angle.✓ (9)

4.2
- Feed
- Anvils
- Pivoted beater
- Discharge (4)

[20]

QUESTION 5

5.1
A Product oxygen gas
B Suction filter
C Waste nitrogen
D Liquid-oxygen storage
E Oxygen liquid
F Superheater
G Lower column
H Upper column (8 × 1) (8)

5.2
- Sulphur is burned.
- As the gases from the combustion chamber pass through the heat exchanger
- they heat the water for the boilers.
- The cooled gases are pumped into the absorbers through an acid-proof pump.
- The temperature of the vapours coming from the steaming tower usually runs at 70 °C.
- The vapours are cooled
- and passed through the drying tower with sulphuric acid.
- The sulphur dioxide is liquefied by compression and cooling.
- It is stored in steel cylinders. (9)

5.3 $S_{(s)}$✓ + $O_{2(g)}$✓ $\xrightarrow{\Delta}$ $SO_{2(g)}$✓ (3)

[20]

QUESTION 6

6.1 This is a chemical reaction in which mobile hydrated ions of a solid are exchanged,✓ equivalent for equivalent,✓ for ions of like charge in solution.✓ (3)

6.2
- Silica is not removed by hydrogen-cation exchange or sodium zeolite exchange.
- It is only partially removed in a cold or hot lime-soda process.
- It can form a tenacious scale.
- It may be removed from feedwater by the use of dolomitic lime or activated magnesia in the softener.
- If preliminary coagulation and settling are carried out
- the use of ferric coagulation will remove some silica.
- These are especially suitable when the silica concentration of makeup water is high.
- Such methods do not entirely remove the dissolved silica
- but they do lower its concentration to a point where adequate blowdown will eliminate the danger of scale in a boiler.
- The most used method of producing water with only a trace of silica is demineralisation. (10)

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6.3
- Temporary hardness
- Permanent hardness (2)

6.4 6.4.1 CaR_2✓ + $2H_2O$✓ + $2CO_2$✓ (3)

6.4.2 MgR_2✓ + H_2SO4✓ (2)
[20]

QUESTION 7

7.1
- Tough and ductile
- Fatigue and shock resistance
- Easily welded (3)

7.2
- Martensitic stainless steel
- Ferritic stainless steel
- Austenitic stainless steel (3)

7.3 7.3.1
- Addition of an aliphatic aldehyde
- Addition of an aromatic aldehyde
- Formation of hydroxylamine or salts (Any 2 × 1)

7.3.2 It is one of the important ways of introducing nitrogen✓ into hydrocarbons.✓

(2 × 2) (4)
[10]

TOTAL: 100

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