THE PAPUA NEW GUINEA UNIVERSITY OF TECHNOLOGY

DEPARTMENT OF MINING ENGINEERING

2020 SECOND SEMESTER EXAMINATION

FOURTH YEAR MINERAL PROCESSING ENGINEERING

MP424 – Bulk Materials Handling in Mines

DATE: ***THURSDAY, 29TH OCTOBER, 2020***

TIME: ***12:50 AM***

TIME ALLOWED: **3 HOURS**

INFORMATION FOR CANDIDATES:

1. You have 10 minutes to read this question paper you **SHOULD NOT** begin writing during this period.
2. There are **FOUR** questions altogether. Answer **ALL FOUR** questions. Marks to each question are shown on the paper.
3. **ALL** answers must be written on the answer book provided. No other written material will be accepted.
4. Write your **NAME** and **NUMBER** clearly on the **ANSWER BOOK**. Do this **NOW**.

QUESTION 1. (Stockpile Design)

a. i. Stockpiles are a common material handling technique used in almost all mines and they are used for various reasons or purposes. They come in different sizes, shapes and techniques for handling them. State and explain briefly at least 2 main purpose of using stockpiles in the mines (concise description is required).

ii. The two most common problems faced in stockpiles are; Segregation, and Degradation. Briefly describe what these problems are and explain how one can control or limit each.

(5 + 5 marks)

b. A mine requires a stockpile ahead of its processing plant and it is considering whether to use either a conical stockpile OR a windrows radial stockpile. The issues the mine considers that are critical to the selection of the two methods are; space, capacity requirement, cost of establishment operation, maintenance, and ease and simplicity. As such discuss the applicability of each stockpile comparatively considering the critical issues pointed out.

(5 marks)

c. Consider that a gold mine, is expected to process ore at a mill feed rate of 150 t/hour, and is planned to operate on a 3 shifts per day, 7days a week, and 52weeks per year shift schedules. However it is expected that the average operating down-time at the mill at any one time is 4 hours. It is planned that production surges from the mine during the down-time at the mill be kept in a stockpile ahead of the mill to make sure the mine production operation is not affected as a result. Given these, design a conical stockpile with a single draw-point (i.e. recommend stockpile size) to be constructed ahead of the mill. It is known that the material has a density of 1800kg/m^3 , and angle of repose of 38^0. The draw-point design is expected to result in an angle of draw-off of 45^0.

Useful formula; $R = \frac{Tan^2(A)}{(Tan\ A + Tan\ B)^2}$, *(all symbols carry the usual meaning)*

(5 marks)

QUESTION 2: (Bins/ Hopper Design)

a. Bins/hopper design requires the establishment of the flow function of bulk materials. It is essentially a plot of unconfined yield stress versus the consolidating stress. Describe what it shows and explain how it is used for design.

(5marks)

b. For a bulk material handling facility you are required to have 200 tonnes of bulk solids in bins/hopper storage as temporary surge capacity, as such design a massflow conical bin/hopper where the bin diameter must not exceed 3m. Your design must specify dimensions of bin/hopper with neat sketches. Appropriate hopper angle to achieve massflow is 20^0.

The relevant material flow properties include; critical flow factor (f_{fc}) being 1.15, flow function shown by figure 1 below, and the bulk density is 2500kg/m^3.

Useful formula; $Ba \geq = \frac{2\sigma_{yc}}{\rho_b g}$, *(all symbols carry the usual meaning)*

(10 marks)

QUESTION 3: (Belt Conveyor Design)

a. A gold mine is to use belt conveyor as an alternative cost effective way to transport ore from the pit to the mill at a production rate of 500 t/hr. Crushed ore from an in-pit primary crusher will be conveyed over a distance of 1000m to the secondary crusher stockpile at the mill. The belt conveyor is to be located on a slope of 10^0 upward against gravity The combination of belt-width and belt-speed that gives the optimum belt conveyor operation is 650mm and 2.0ms^{-1} respectively. Properties of the material include; crushed ore is lumpy and moderately abbrassive, bulk density is 2800kg/m^3, angle of repose is 38^0, and angle surcharge is 25^0 with a shape factor of 0.184 based on idler configuration that gives the optimum value, where 127mm sizes 3-roll idlers sets are used for average duty roles, K_{SR} = 0.1. The mass of the moving parts of the belt are; m_{ic} = 19.5kg/m, m_{ir} = 5.0kg/m, m_b = 16.0kg/m.

Useful formulae: $F_{fb} = 0.025 \times Mc \times g \times L$; $F_{fL} = 0.025 \times M_L \times g \times L$; $F_{st} = (m_s/v) \times g \times H$; $F_N = K_{SR} \times F_H$. *(all symbols carry the usual meanings)*

Given these, determine the the motor size/ power required to operate the belt conveyor system if the power transmission efficiency rating is genergally 90 %. (show all your workings).

(10 arks)

QUESTION 4: (Slurry Transport Design)

a. Draw a neat sketch of a total slurry handling system for handling bulk solids from the mine to the utilization point with appropriate labels of the main design features of the system.

b. Explain briefly what fluid rheology is?

c. Describe so as to distinguish between what a Newtonian fluid is and a Non-Newtonian fluid with the help of a neat sketch.

d. Explain so as to distinguish between the two types of flow regimes for slurries; Homogeneous and Heterogeneous flow, with the help of neat sketches.

(5 + 5 + 5 + 5 marks)

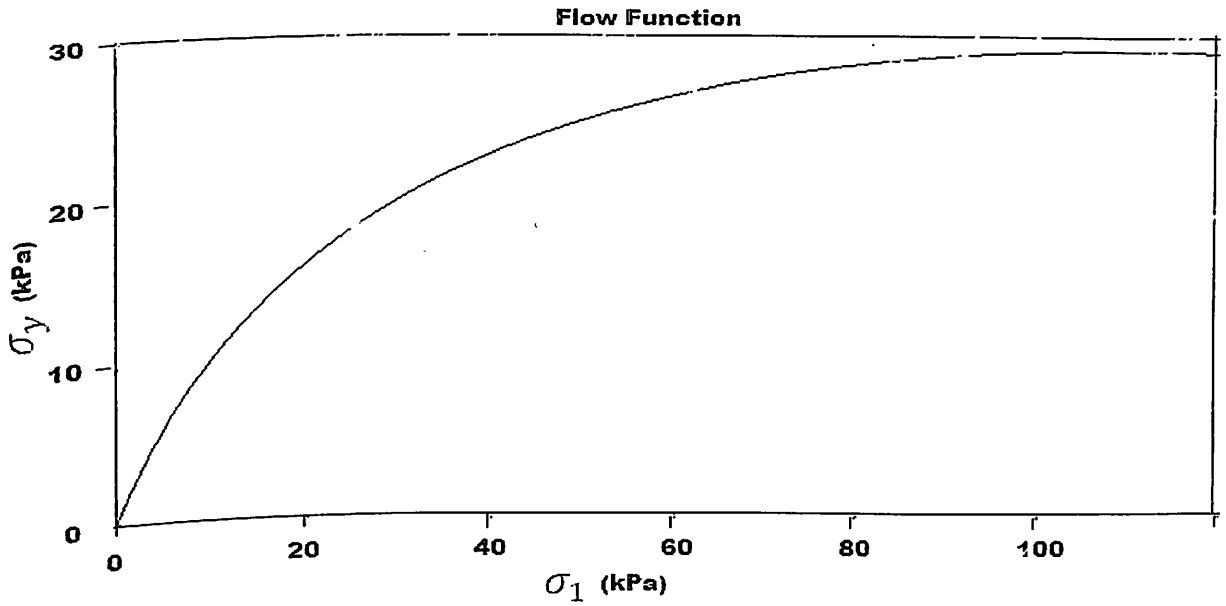

Figure 1: Flow function graph