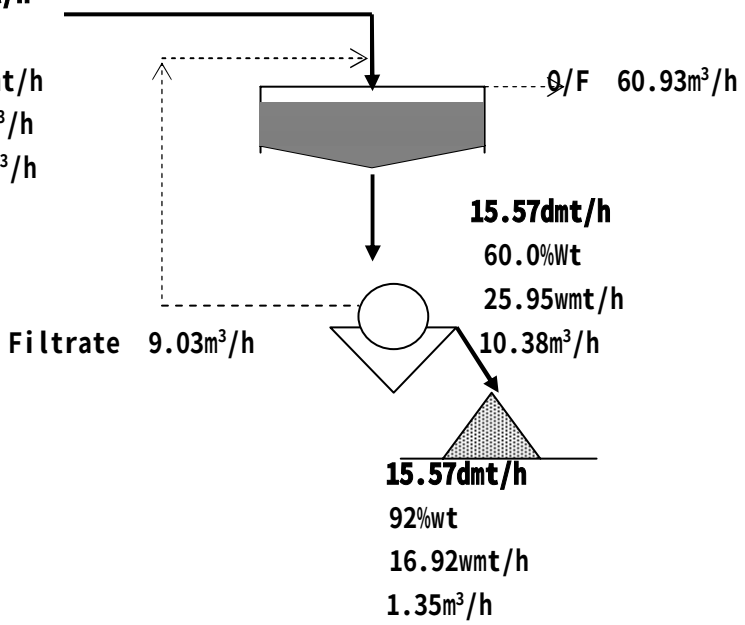
## 12.Concentrate disposal

### 12-1. concentrate thickener

### 12-1-1. Calculations of required water area

**1]Material balance**

Ore dry tonnage 15.57dmt/h
Pulp density 20%Wt
Ore wet tonnage 77.85wmt/h
Water volume 62.28m³/h
Pulp volume 66.08m³/h




**2] Calculation of thickener size**

Settling theories of Coe-Clevenger and Talmge & Fich which are often used in chemical engineering and waste water treatment fields have not so often been adopted for mining or sewage water processing where they use simple and practical methods. It is difficult to explain complex mass phenomena by single equation.

Water area of the thickener A is given by the following equation.

$$A = \frac{Q}{v\alpha} \qquad [m^2]$$

where Q: flow rate of up flow [m³/h]
V: settling velocity [m/h]
α : factor based on areal efficiency

The settling velocity V was determined to be 0.21m/h by laboratory tests, however, factor should be 0.6 for safety to meet problems due to characteristics of the ore, pulp density and temperature, etc.。

Then $A = Q/v = 60.93\ m^3/h \div (0.21m/h \times 0.6) = 483.6m^2$

Thickener diameter D is given by the following equation.

$$D = \sqrt{\frac{4A}{\pi}}$$

Hence $D = \sqrt{\frac{4 \times 483.6}{3.14}} = 24.8\ m\phi \rightarrow 26.0m$

Check by estimated flow rate v'

$V' = Q/A = 60.93\ m^3/h \div (3.14/4 \times 26^2)m^2 = 0.15m/h < 0.21m/h$...OK

Spigot pulp density is determined by detention time in the thickener.

Tank volume : cylindrical part ; $V_1 = \frac{\pi}{4} D^2 H_1 = \frac{3.14}{4} \times 26^2 \times 3.0 = 1,592 m^3$

Conical part ; $V_2 = \frac{1}{3} \cdot \frac{\pi}{4} D^2 H_2 = \frac{1}{3} \times \frac{3.14}{4} \times 26^2 \times 1.0 = 177\ m^3$

Total ; $V = V_1 + V_2 = 1,592 + 177 = 1,769\ m^3$

Detention time : $T = V/Q = 1,769\ m^3/(66.08 + 9.03)\ m^3/h = 23.6h$

In the case of concentrate thickeners, the detention time T ranges generally between 20 to 30 hours a day. So the above result will meet this demand.

Required torque for raking varies depending on capacity per unit area, spigot density, particle size distribution and solid specific gravity etc.

Manufacturer's data of maximum torque are shown in the following.

Maximum torque t [m-kg]

| Tank dia.[m] | Light duty | Standard | Heavy duty |
|---|---|---|---|
| 18-25 | 3.24 | 10.13 | 20.25 |
| 27-30 | 10.13 | 20.25 | 47.25 |

Required power kw is given by the following equation.

$$Kw = \frac{t \cdot rpm}{0.9462 \times \eta}$$

where t: the maximum torque [m·t]

rpm: revolutionary speed 0.075 [rpm]

η : raking mechanical efficiency 0.4～0.6

then in the case of standard duty of 27 m diameter

$$Kw = \frac{20.25 \times 0.075}{0.9462 \times 0.5} = 3.21\ kw \rightarrow 2.2kw \times 2\ sets$$

## 12.2. Filters

### 12.2.1. Type selection

#### 1] Disc filter

At initial stage of design, since required moisture for concentrate ship was very severe. So it was indispensable to install dryer, disc filter was studied because of its low price. Since it was expected to achieve this moisture by drum filter only and aid of natural drying, this plan was rejected.

#### 2] Filter press

Filtration performance was excellent, however, there were no large models at that time, in addition it was very expensive. So this type was excluded from target.

**3] Belt filter**

It has relatively bigger capacity, however, performance was not good at that time. So it was not selected.

**4] Drum filter**

It has a lot of experiences in domestic and overseas mines and it was expected to satisfy required capacity and filtration performance. So this drum filters were selected.

## 12.2.2.Calculation of required filter area

**1] Areal load**

After Taggart, he recommended areal load of 60～80 lb/ft$^2$･h, namely300～400kg/m$^2$･h. Generally speaking, areal load of slimy ore should be smaller than these value. Base on leaf tests in the laboratory, we determined capacity per unit area,i.e. areal load L as 250dkg/m$^2$、surplus 20% and 8%wt of cake moisture.

**2] Calculation of required filter area**

Based on the material balance in section 12-1-1, required filter area Af can be calculated by the following equation.

$$A_f = \alpha \cdot T/L$$

Where T: dry tonnage of concentrate [dmt/h]

L: areal load [dmt/m$^2$]

Then $A_f = 1.2 \times 15.57 dmt/h \div 0.25 dmt/m^2 = 74.74 m^2$

Matching model to this area, will be two sets of CD-1014 made by SANKIENGINEERING CO. Ltd with filter area @40.8m$^2$.

Check $40.8 m^2 \times 2 = 81.6 m^2 > 74.74 m^2 \cdots$OK

Capacity can be regulated by slurry level, vacuum pressure and revolutionary speed of drum, besides filter cloth can be exchanged in several hours. So stand-by machine shall not be installed.

Vacuum pump capacity Qs should be 0.3～1.0m$^3$/m$^2$･min per filter area and reciprocating type of 1.1m$^3$/min will be recommendable for the altitude to be installed.

$Q_s = 81.6 m^2 \times 1.1\ m^3/m^2 \cdot min = 89.76\ m^3/min$

Proper type of the vacuum pumps will be UNOZAWA PVY923:@46m$^3$/min×90kw×2sets.

Check $46\ m^3/min \times 2 = 92\ m^3/min > 89.76\ m^3/min \cdots$OK

The air compressor for cake discharge should be same type of 15 kw with for grinding in spite of small air consumption due to snap blowing.

It is unnecessary to install filtrate pump, because enough head will be gotten under moisture traps.

## 12-3.Comcemtrate conveyor

### 12-3-1.Selection of belt specifications

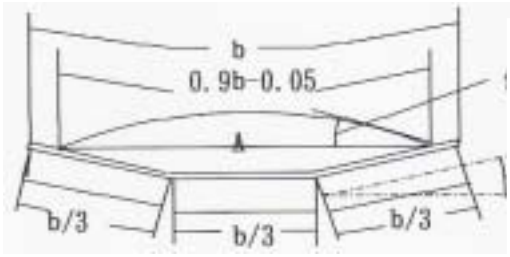
#### 1] Design concept

Required capacity： 20 mt/h
Maximum ore size： 74 μ (200 mesh)
Actual sp. Gr.： 4.1
Apparent sp. Gr.： 2.0
Angle of repose： 50°
Conveyor length： 42.5m
Belt width： 0.4 m
Belt weight： 4.5kg/m
weight of revolving parts W1： 22.4 kg/m

#### 2] Conveyor capacity

$$Q_m = Q_t / \gamma = 60 \cdot k_1 \cdot K_2 \cdot (0.9b - 0.05)2 \cdot v$$

where $Q_m$ : Transporting capacity [m3 /h]
$Q_t$ : Required tonnage to be conveyed 20 [mt/h]
$\gamma$ : Apparent sp.gr. 2.0 [t/ m3 ]
$k_1$ : Factor based on conveyor slope 0° 1.0
$K_2$ : Factor based on trough angle and surcharge angle 20° ; 0.1245
v : Belt speed 37 [m/min]
b : Belt width 0.40 [m]




Surcharge angle

Trough angle

$Q_m = 60 \times 1 \times 0.1245 \times (0.9 \times 0.4 - 0.05)2 \times 37 = 26.6$ mt/h > 20 mt/h..OK

#### 3] Required power P:

$$P = P_1 + P_2 \pm P_3 + P_t$$ [kw]

Power without load $P_1$ : $P_1 = 0.06fWv(l + l_0)/367$ [kw]
Power for horizontal load $P_2$ : $P_2 = f \cdot Qt\ (l + l_0)/367$ [kw]
Power for vertical load $P_3$ : $P_3 = \pm h \cdot Q_t /367$ downward− [kw]
Power for tripper $P_t$ : $P_t = 0$ [kw]

Where l : horizontal length of conveyor (distance between axis and axis of pulleys) [m]
$l_0$ : calibrated horizontal conveyor length [m]

h : lift [m]
$Q_t$ : tonnage to be carried [mt/h]
v : belt speed [m/min]
W : weight of revolving parts without load [kg/m]
$W_1$ : weight of belt [kg/m]

Then B=400mm, $Q_t$ =20 mt/h, h=0m,l= 42.5m, v=37m/min, rubber lagging
Driving pulley, θ :200° =3.49rad, μ=0.3, W=22.4kg/m, f=0.03
Hence $P_1$ =0.06×0.03×22.4×37×(42.5+49)/367=0.371kw
$P_2$ =0.03×20×(42.5+49)/367=0.15kw
$P_3$ =+(0×1,340)/367=0
$P_t$ =0
So P =0.371+0.15=0.521kw
Recommended motor power $P_m$ will be 0.521/0.8=0.65kw.
Installed motor should be 5.5kw as same as #16～#19BC in the crushing plant in order to minimize motor spares.

## 12-4. Concentrate stock yard on mine site

### 12-4-1. Stock yard

#### 1] Design concept

Inventory on mine site: Normally 2,000 Wmt (Stock of about 5days, maximum3,000 Wmt
Apparent sp.gr.: 2.0t/ $m^3$
Stock method : Pile up by bucket loader
Height of pile: H =5.0 m maximum

#### 2] Calculation of dimension

Stock volume: V=3,000 t÷2.0t/ $m^3$ =1,500 $m^3$
Required area: A=V/H=1,500 $m^3$ ÷5 m=300$m^2$
Installed area: 12mW×40mL=480$m^2$ ＞300$m^2$…OK
Dimension of yard : 12mW×40mL×6mH=2,880 $m^3$＞1,500 $m^3$…OK

### 12-4-2.Loading equipment

#### 1] Design concept

Loader type : wheel loader with 2 $m^3$ bucket
Loading time : 1minute/batch
Loading volume : 5 $m^3$/truck

#### 2] Calculation of required number of trucks

Required time per a truck: 5 $m^3$/truck÷2 $m^3$/batch×1min/batch
=2.5min/truck→3.0min/truck

Required loading time a day: 3.0min/truck×40trucks/day＝120min/day→2h/day

Then one unit of loader will be sufficient, so it will be shared with other divisions, including 2.5t class bulldozer for pile up.

## 12-5. Concentrate trucks

### 12-5-1.Design concept

Distance between mine and port:Uskan-100 km-Ranau-15 km-Mamut；total 115km

Truck speed: 30 km/h

Loading capacity: 10 Wmt/truck

Number of trips: 1 round trip/day・truck

Availability: 80%

### 12-5-2. Calculation of truck number

Required time for one-way: 115 km×2/ 30 km/h＝7.6 h/day

Required trip number: 400Wmt/day÷ 10 t/trip＝40 trips

Required No. of trucks: 40trips÷1trip/truck＝40 trucks

Total No. of trucks: 40trucks÷80%/100＝50trucks

End