DESIGN OF BELT CONVEYOR TO INCREASE THE EFFICIENCY OF FINISHING GOOD PRODUCT TRANSFER FROM WAREHOUSE 1 TO WAREHOUSE 2 IN PT XY

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Abstract
This research aims to find out how much capacity that could have produced a conveyor according to the rpm speed of the motor and conveyor dimensions as well as to determine the selection of the components that are used as system power supplier. This research was carried out based on the calculation of the design of conveyor design guide book and catalogue containing components of belt conveyor. Results of the design is to be used as a guide for designing a conveyor to transport box containing intravenous fluids in PT XY. After the design resulted in two conveyors with 22.5 m long dimension, 40 cm wide belt and 0.5 m / s speed with inclination angle of 30^0 and 25^0. The conveyor has a carrying capacity of 300 boxes / hour (4.3 ton / jam). For power supply systems used 1.5 kw AC motor, WPX 80 type gearbox reducer ratio 1:10 s / d 1:60, S 400/4 type belt, drive pulley ϕ 500 mm, roller idler ϕ 89 mm, take-up type screws, transition roller chain number 40, number of teeth Z_1= 21 and Z_2=50, sprocket ϕ 90.5 mm and ϕ 209.5 mm, SAE type 10 oil (43 cSt, 200 SUS at 37.8^0C).

Keywords: *Design, Belt conveyor, Chain rollers*.

INTRODUCTION

Health is an important and very decisive aspect in building the human element so that it has the quality expected. The quality of health services cannot be separated from the availability of supporting factors themselves. One of them is the availability of infusion solution. According to Nila F. Muluk (2017) intravenous fluids are basic medicines that are widely used in health services. In 2012, the use of infusion reached 104.5 million bottles. This figure is confirmed to continue to increase in line with the increasing number of JKN (National Health Insurance) participants, which currently is around 179 million people.

PT XY is a manufacturer of basic intravenous solutions, apharmaceutical company that produces intravenous basic products and is the largest producer of basic intravenous products and a market leader in Indonesia. PT XY is a make to stock company with a production capacity of PT XY is 90 million btl/year.

So far, warehouses for packaging materials and finished products have been placed in one area, namely warehouse 1 and warehouse 2. Warehouse 1 is for storing packaging materials and production line 3, while warehouse 2 is for storing packaging materials and production lines 1 and 2. With the size of each warehouse 1 is 15 mx 10 m and warehouse 2 is 32 mx 30 m, and has a capacity of 50 pallets or 3600 boxes for warehouse 1 and 200 pallets or 14400 boxes for warehouse 2.With line 3 packaging target of 1550 boxes/shift (21.5 pallets/shift) or 4650 boxes/day (64.5 pallets/day) warehouse 1 is unable to accommodate finished products/finishing good products and added packaging materials causing warehouse 1 to frequently over storage.

Due to frequent over storage in warehouse 1, PT XY made a new policy, namely separating warehouses, warehouse 1 specifically for packaging materials and warehouse 2 specifically for finished products/finishing good products. This is done to improve the quality of the product and to facilitate the distribution of goods at PT XY.

So far, the transfer of finishing products has been done with the help of a forklift. However, moving the product with the help of a forklift is less effective for areas where the distance is close and the flow of goods is continuous. One of the efforts to solve this problem, the researchers implemented a material moving machine in the form of a conveyor to facilitate the transfer of finishing good products from warehouse 1 to warehouse 2.

METHODOLOGY

1. Initial Data Collection

   The initial specifications set by the researcher

   - Desired specification: 300 boxes per hour
   - Conveyor length 1 (L1): 22.5 m
   - Conveyor length 2 (L2): 22.5 m
   - Conveyor belt speed : 0.5 m/s
   - Conveyor ramp angle1 (β1): 33^0
   - Conveyor angle 2 (β2): 25^0

   Location and temperature.

   - Location : *indoor* and *outdoor*
   - Temperature : 23^0 C – 37^0 C
   - Distance of loading area to reception area: 44 m

   Transport material specifications

   - Infusion box weight: 11.5 kg
   - Material size: 380 mm x 260 mm x 230

2. Calculation
   - Infusion box weight: 11.5 kg
   - Material size: 380 mm x 260 mm x 230

3. Figure Design Making

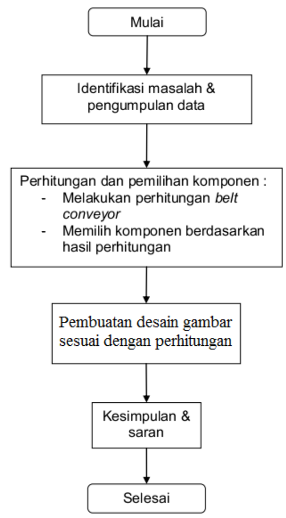

Figure 1. **Research FlowChart**

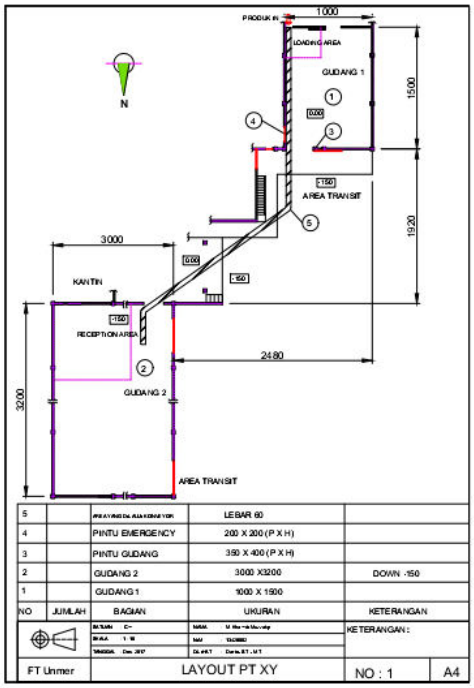

Figure 9. ***Layout* PT XY**

RESULT AND DISCUSSION

Based on the calculation results, the conveyor specifications with a capacity of 300 boxes/hour include:

- Conveyor capacity

  Q = 4.3 tons/hour.

  For the distance between the average boxes (a), namely: a = 4.8 m

  Long union material weight

  q = 2.4 kg/m.
- Width

  Belt width (B) is selected based on the size of the material carried, namely 380 mm x 250 mm x 230 mm, so that the standard belt width chosen is 400 mm with the number of belt piles i = 4 plies and the weight of the long unity belt qb= 4.18 kg/m.
- Idler roller design

  It is planned that the idler roller width Bf= 500 mm. The spacing of each roller on the tense side of the belt, l1 is 1000. As for the returnidler, 12 = 11. 2 = 2000 mm.

  Idler roatating parts weight:

  $$G''_p = 7\ kg$$

  So that the idler rotating parts weight per meter is:

  $$q'_p = 7\ kg$$

  On the reverse side of the belt

  $$q''_p = 3{,}5\ kg$$

  The idler roller is planned to have an inner diameter of, d = 89 mm, then the maximum stress that occurs is σmax = 0.89 Kg/mm^2. For this we can use a plate material with a thickness, t = 6mm with ST50 steel which has a maximum bending strength of, σb=3.02 Kg/mm^2.

  It is planned that the shaft has the smallest diameter, d=20 mm and the diameter, D=22 mm with the radius, r=1 mm and the shaft length, L=596 mm. So that the stress concentration factor is obtained, Ks=1.0. Then the maximum normal stress value is obtained, σ_{max} = 77.68 Kg/mm^2. So that the shaft can be made of steel ST 42-1 which has a tensile strength of, σb=410 N/mm^2.
- Idler Roller Bearing Selection

  Deep Grove Ball type bearings - DIN 625 no Bearing. 6004.

  Bearing dimensions used:

  - Diameter in d = 20 mm
  - Outer diameter D = 42 mm
  - Bearing width B = 12 mm
  - Basic load C = 453.60 Kg
  - Radial load Pr = 16.79 Kg
  - Axial load Pa = 0
  - The equivalent load P = Pr = 16.79 Kg
  - Bearing life L_h = 23230.11 hours
- *Drive Pulley* design
  - Pulley Width

    Bp = B + 100mm = 500mm
  - Pulley Diameter

    Dp ≥ k. I

    K = 125 is chosen, so that the pulley diameter Dp = 500 mm.
- Take Up design

  For the belt fastening system in this planning it is done by using a take-up screw.

- Power transmission system design
  AC electric motor specifications according to the "Technical Catalog" are as follows:
  - ✓ Motor type: 3 ph induction motor
  - ✓ Voltage source: AC-400 v-50 Hz
  - ✓ Designation number: TH-TBH
  - ✓ Average output power: 1.5 KW
  - ✓ Output shaft rotation: 2870 rpm
  - ✓ Power factor: 0.76
  - ✓ Efficiency: 81%
  - ✓ Moment rate: 4.99 Nm
  - ✓ GD2 gut moment: 0.00168 Kgm
  - ✓ Motor weight: 14.2 Kg
  - ✓ Starting: Y/Δ (star - Delta)
- Chain transmission planning
  According to the previous data it is known:
  - ✓ Motor power Pm = 1.5 kw
  - ✓ Gearbox ratio igb = 1:10
  - ✓ The motor output shaft rotation n = 2870 rpm
  - ✓ Gearbox output rotation n1 = 143.5 rmp
  - ✓ Drive pulley speed v = 0.5 mps
  - ✓ Drive pulley diameter Dp = 500 mm
  - ✓ Axle distance (planned) C = 400 mm

Pulley rotation are:

$$n_p = \frac{60 \cdot v}{D_p} = 60\, rpm$$

So the transmission ratio is:

$$\mathrm{i} = \frac{z_2}{z_1} = \frac{n_1}{n_2} = \frac{143{,}5}{60} = 2{,}3$$

a. Roller chain number and roller chain size. The chain number to be used is NO.40, with the size of the roller chain as follows:
   - ➢ Chain width W = 7.95 mm
   - ➢ Rivet length L_1 = 8.25 mm
   - ➢ The length of the connecting pen L_2 = 9.95 mm
   - ➢ Chain height from distance line for sproketh = 10.4 ± 0.05 mm
   - ➢ Chain height H = 12 ± 0.05 mm
   - ➢ Number of teeth on the driven shaft Z1 = 21 teeth (planned)
   - ➢ Number of teeth on the Drive shaft

$$\mathrm{Z2} = \frac{z_1 \cdot n_1}{n_2} == 50\, tooth$$

b. Distance diameter for both sprockets
   - ➢ Drive Sprocket $d_p = 85{,}2\, mm$
   - ➢ Driven Sprocket

   $D_p = 201{,}59\, mm$

c. Outer diameter of both sprockets
   - ➢ Drive Sprocket $d_k = 90{,}5\, mm$
   - ➢ Driven Sprocket

   $D_k = 209{,}5\, mm$

d. Naf diameter for both sprockets
   - ➢ Drive Sprocket

   $dB_{max} = 70{,}81\, mm$
   - ➢ Driven Sprocket

   $DB_{max} = 189.12\, mm$

e. Second circumference speed
   - ➢ Drive Sprocket

   $v1 = 0{,}64\, m/s$
   - ➢ Driven Sprocket

   $v1 = 0{,}64\, m/s$

f. Axis distance in dividing distance

   $C_p = 31{,}5\, mm$

g. The length of the roller chain in dividing distance

   Lp =103,9

h. Load acting on one roller chain, F.= 239 kg

i. Type of lubrication and way of lubrication

$$v_{1,2} = 0{,}64\; m/s = 38{,}4\; m/min$$

For circumference speeds of less than 600 m/min, use dip/drop lubrication (sularso.1980, p. 205).

- Normal Temperatur

SAE 10 (43 cSt, 20^0 SUS at $37{,}8^0$C)

- Temperature of 30^0-60^0

SAE 20 (65 cSt, 30^0 SUS at $37{,}8^0$C)

CONCLUSION

From the description of the calculation of the conveyor belt planning that has been calculated in the previous discussion, it has been concluded that the planned conveyor belt is able to meet the transport target of 300 boxes per hour with a travel time of 88 seconds per box, so that the use of forklifts can be reduced in transporting finishing good products from warehouse 1 to warehouse. warehouse 2 at PT XY.

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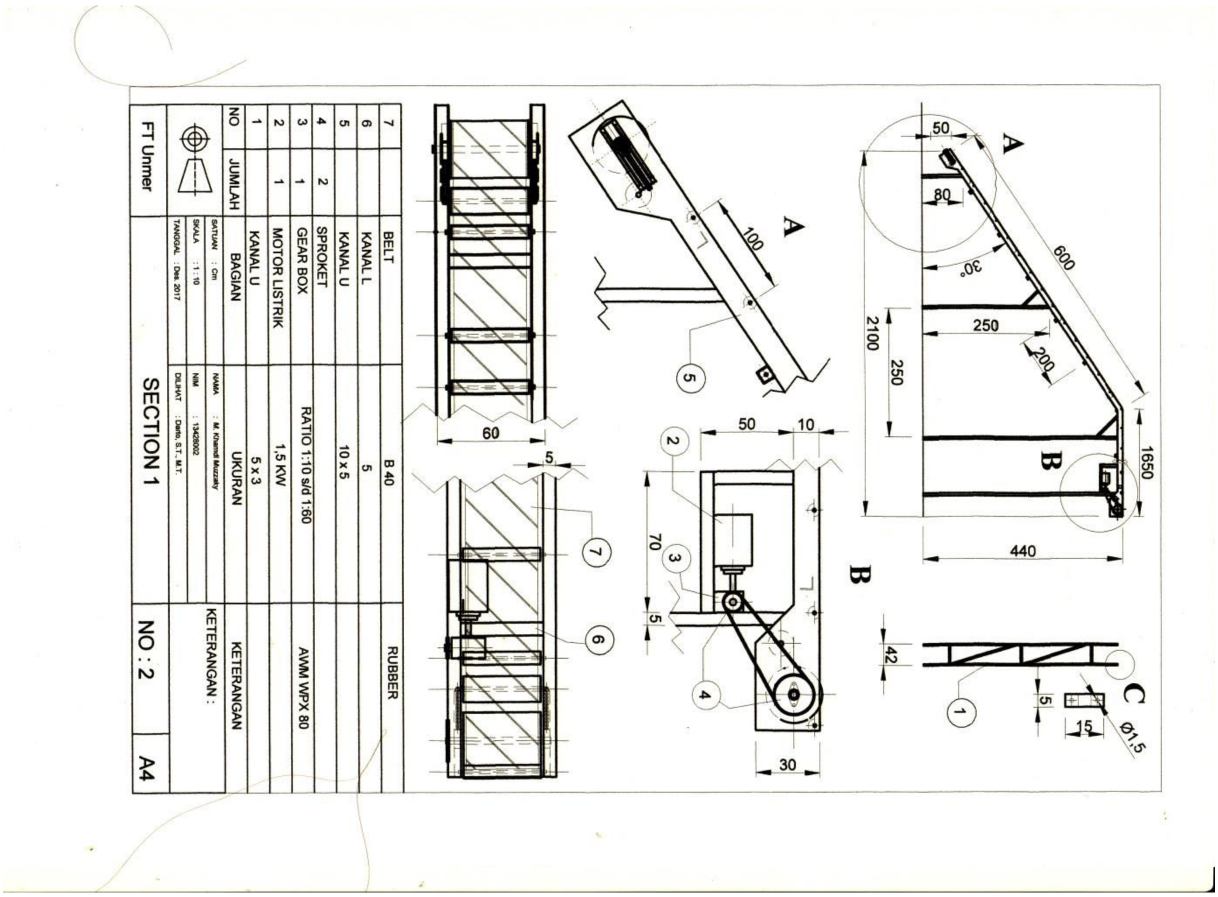
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SECTION 1
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7 BELT B 40 RUBBER
6 KANAL L 5
5 KANAL U 10 x 5
4 2 SPROKET
3 1 GEAR BOX RATIO 1:10 s/d 1:60 AWM WPX 80
2 1 MOTOR LISTRIK 1,5 KW
1 KANAL U 5 x 3
NO JUMLAH BAGIAN UKURAN KETERANGAN
KETERANGAN :
SATUAN : Cm
SKALA : 1 : 10
TANGGAL : Des. 2017
NAMA : M. Khamdi Muzzaky
NIM : 13428002
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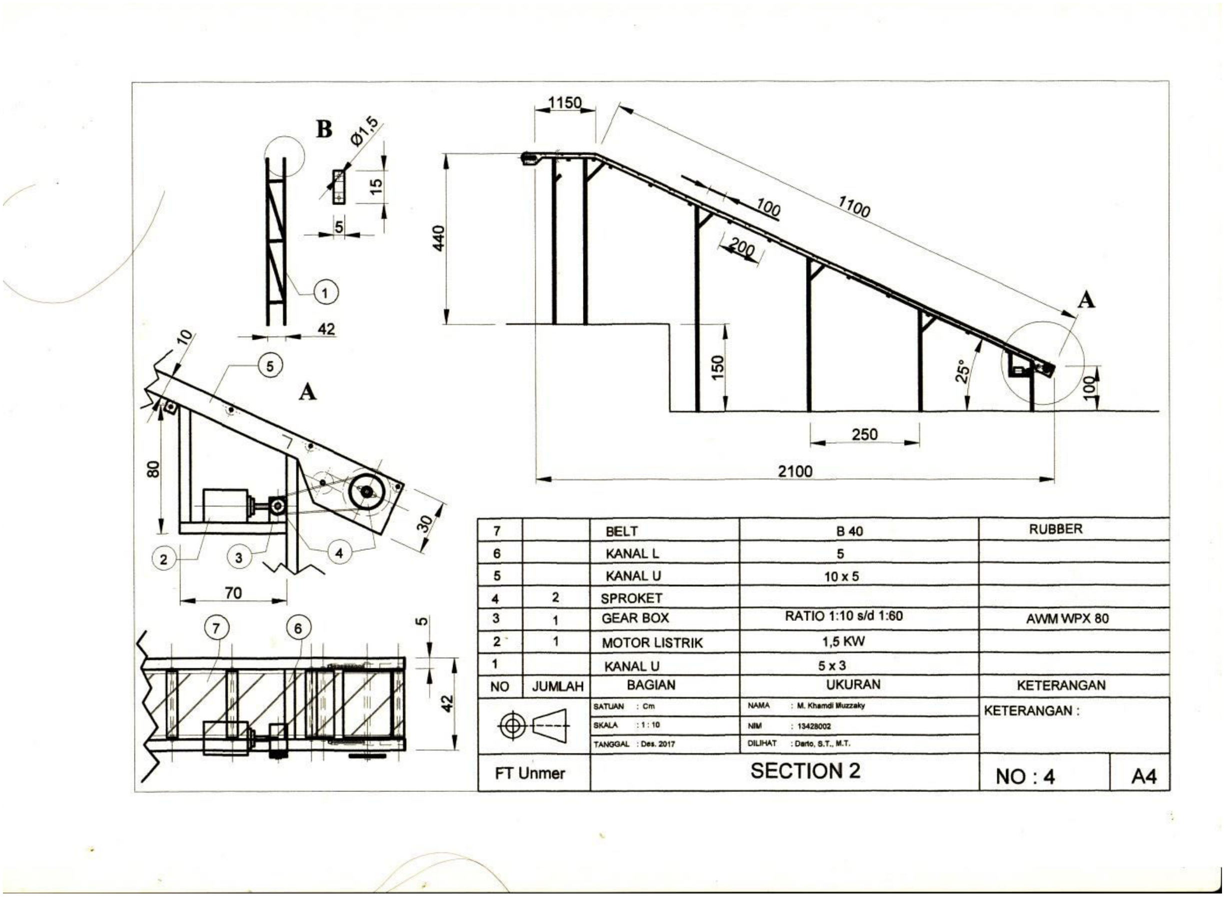
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KETERANGAN :
SATUAN : Cm
SKALA : 1 : 10
TANGGAL : Des. 2017
NAMA : M. Khamdi Muzzaky
NIM : 13428002
DILIHAT : Darto, S.T., M.T.
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