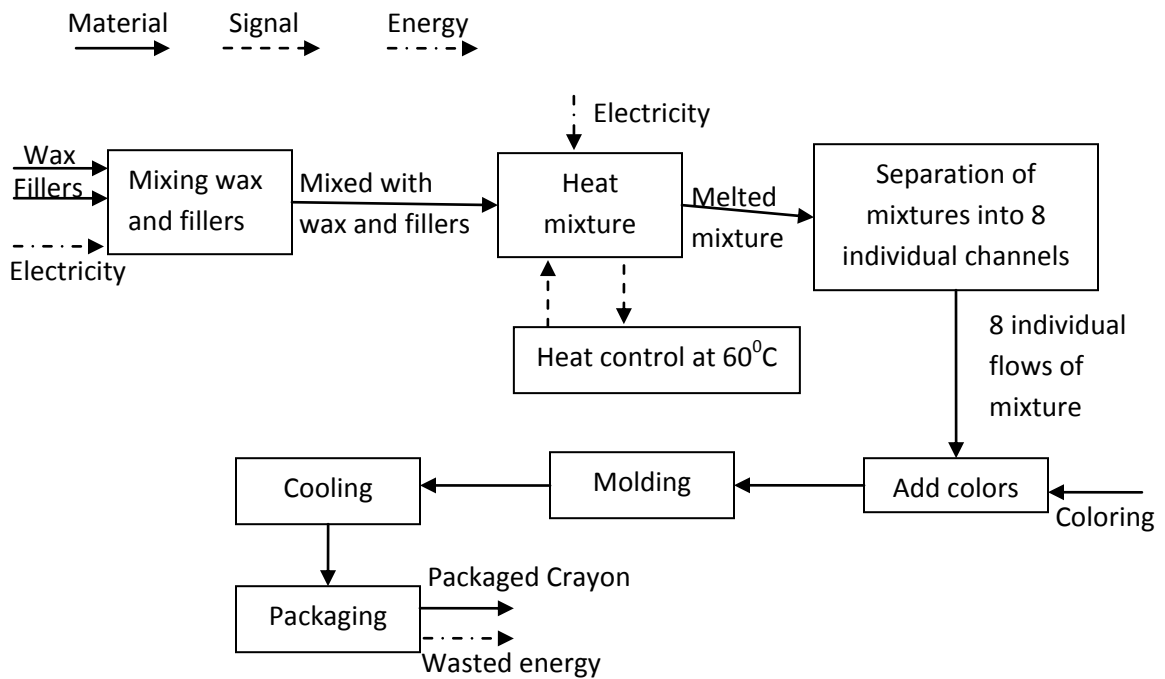


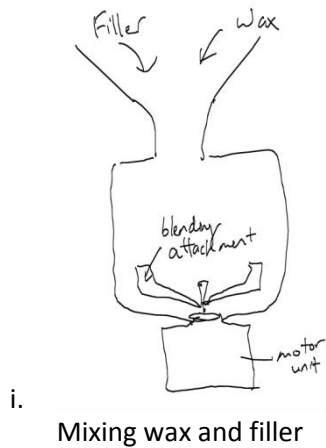
1. Mass production of crayons

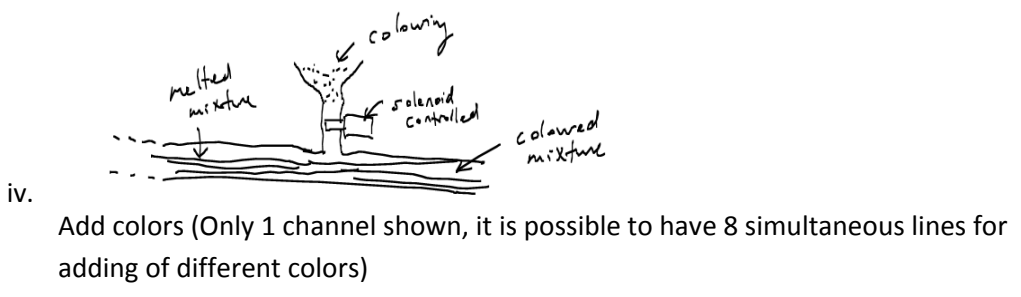
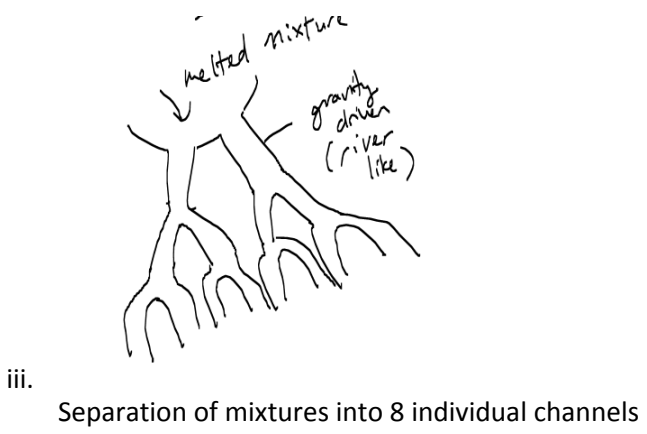
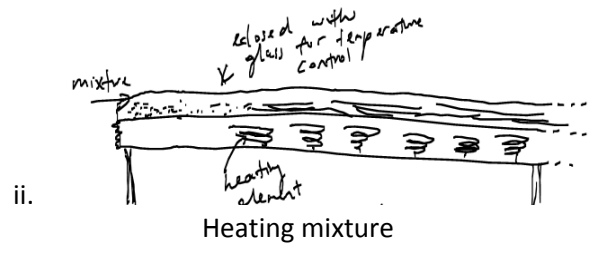
- a. 8 design requirements
 - i. High production rate
 - ii. Safe to use
 - iii. Strong and rigid structure
 - iv. Ensure well mix of different ingredients
 - v. Easy services of consumable parts
 - vi. Ability of different colors production
 - vii. Reusable mold
 - viii. Low machine assembly cost

b.



c.





2.

a.

i.

Criteria	Design Variants		
	Ball point pen	Electric typewriter	Computer printer
High quality of typeface			
Short time operational readiness			
Low cost			
Low space consumption			
High energy efficiency			

ii.

High quality of typeface	Attractiveness of the finishing look, readability of work and consistency of spacing, paragraphing that's produced
Short time operational readiness	Time required to start outputting making of text symbols
Low cost	The price tag for each variants
Low space consumption	The size of each design
High energy efficiency	Power consumption (Electricity) of each design

iii.

Criteria	Weights, %			
	10	20	30	40
High quality of typeface				
Short time operational readiness				
Low cost				
Low space consumption				
High energy efficiency				

b.

- i. Direct Safety – Rigid design of hair dryer
- ii. Indirect Safety – Auto shut off power when overhead occurs
- iii. Warnings – Indicate danger area in manual book

3.

a.

i. Assuming supply frequency = 60Hz,

$$900 = \frac{120 \times \text{frequency}}{\text{no. of poles}}$$

$$\text{No. of poles} = 8$$

$$\text{Percent slip} = \frac{N_{slip}}{N_{sync}} \times 100\%$$

$$= \frac{900 - 873}{900} \times 100\%$$

$$= 3\%$$

ii. $N_r = (1 - s)N_{sync}$

$$= (1 - 0.10)900$$

$$= 810RPM$$

b. $Q = 00015m^3s^{-1}$, $A = 75 \times 10^{-4}m^2$, $P\eta_o = 0.85$, $P = 200 \times 10^5Pa$

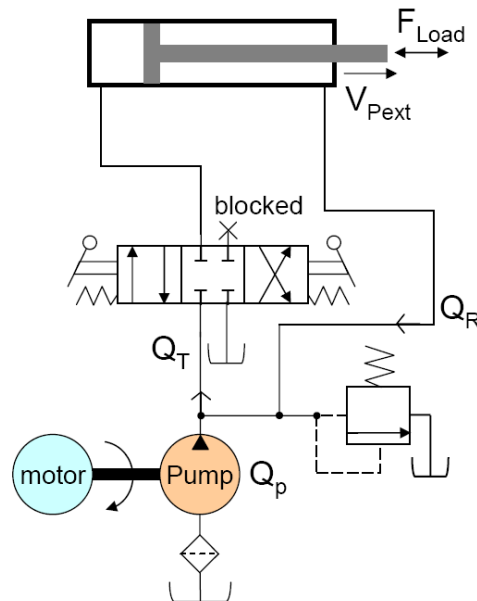
i. Since piston area is twice rod area, extension and retraction speed are equal

1. $v_{ext} = v_{ret} = \frac{Q}{A} = 0.2ms^{-1}$

2. $F = PA = 150kN$

3. $P = FV = 30kW$

ii. $P_{pump} = \frac{P}{P\eta_o} = 35.29kW$



iii.

4. $r = 0.3m, F = 9810N, n_m = 30rpm, m\eta_T = 0.94, m\eta_o = 0.9, P_m = 140 \times 10^5 Pa$

a.

i. $T = rF = 2943Nm$

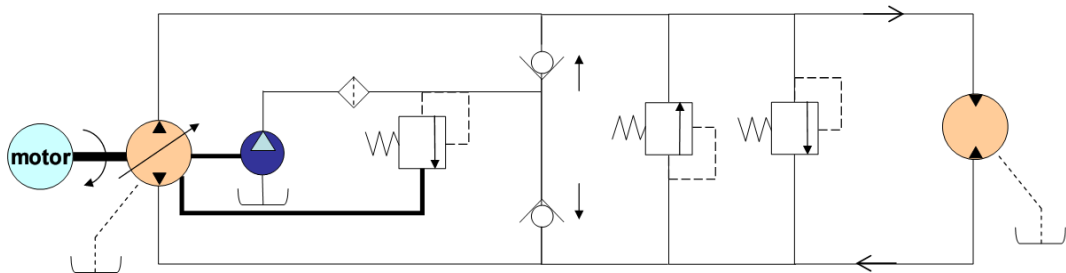
ii. $m\eta_o = \frac{2\pi n_m T_m}{Q_m P_m} = \frac{2\pi \times 30 \times 2943}{Q_m \times 140 \times 10^5 Pa} = 0.9$

$Q_m = 0.044m^3 min^{-1} = 44l min^{-1}$

iii. $output\ power = \frac{2\pi n_m}{60} T_m = 9.245kW$

b. $Power\ required\ for\ pump = \frac{output\ power}{m\eta_o \times P\eta_o}$

$= \frac{9.245kW}{0.9 \times 0.9} = 11.414kW$



c.