ENERGY AUDITING AT THE COMMONWEALTH TILE FACTORY, FEROKE

As part of the course EE6401 Energy Audit and Management, Instructed by Dr Ashok S, NIT Calicut during monsoon semester 2015

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ABOUT THE CANDIDATE FACTORY

Commonwealth Tiles was formed ensuing the formation of Commonwealth Trust (India) Ltd. In 1977 handed over from Basel Mission this venture was also the first step forward in implementing the latest technologies and thereby modernizing its production processes by bringing in the steam engine powered production. The products include roof tiles, wire cut bricks, hollow bricks, ceiling tiles and jally.

EXECUTIVE SUMMARY

Tile making is an energy intensive process consisting of unit operations like clay preparation and mixing, wire cutting, drying and kiln firing. 30-35% of the total energy utilized is electrical energy, the remaining being thermal energy. Fuel cost accounts for about 30-40% of the production cost of tiles.

Energy audit has been conducted in a tile manufacturing unit. Basic data were collected on the energy consuming equipment and their operating parameters. The factory data are analysed to make detailed estimations about specific thermal and electrical energy consumptions and to identify specific energy saving potentials for various processes in tile making.

Most of the electrical equipment used are around 30 years old and suffers from low efficiency. Replacement of standard motors with energy efficient motors is suggested. The most energy consuming region in the industry is the kiln used for baking the tiles. The waste heat produced in the kiln can be used to generate steam using boiler. This steam can be used for meeting power requirements in the factory. Cogeneration can be employed.

Incandescent lamps are used for lighting in the factory. These lamps should be replaced by CFL.

UNIT OPERATIONS

Various processes involved in tile making are illustrated below.

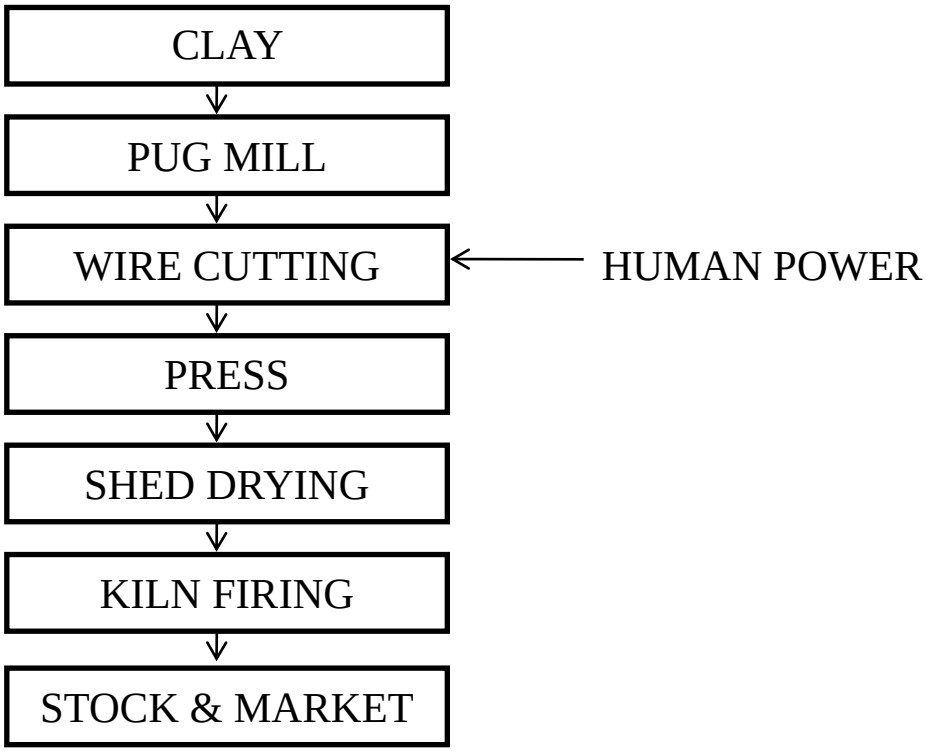


Fig. 1 Tile making flow diagram

The first manufacturing process consists of comminuting the constituents obtaining a homogeneous mixture in a pug mill and preparing the mixture for subsequent forming or moulding process. The clay and other compositional constituents are mixed with water for grinding or milling in rotating mills or ball mills. The resulting suspension then needs to go through a thermal process in order to remove water again and be converted into a semi dry raw material. Forming operation uses the primitive wood moulds that is provided with dimensions. The formed tiles are stacked and natural dried to remove moist that had been supplied in the moulding process. These tiles are then moved to the kiln and baked there at a temperature around 900^0C. The baking will take around 20 hours inside the kiln. The baked tiles are allowed to cool inside the kiln and taken out to the stacking area once again. These are further cooled and made ready for packing.

MACHINE DETAILS

	MACHINES POWERED FROM :			
	GENERATOR 1: 125KVA		GENERATOR 2: 200KVA	
1	H S ROLLER MOTOR	90 HP	D/A MOTOR	90 HP
2	VACCUM PUMP MOTOR	15 HP	D/A MIXTURE MOTOR	75 HP
3	CLAY FEEDER MOTOR	7.5 HP	PAN MILL MOTOR	60 HP
4	D/A CONVEYORBELT MOTOR	5 HP	B- PRESS MOTOR	15 HP
5	BORE WELL PUMP MOTOR	5 HP	KILN FAN MOTOR	5 HP
6	BUMGLOW WATER PUMP MOTOR	5 HP	SPLITTING MACHINE MOTOR	10 HP
7	HAND WOOD CUTTER MOTOR	10 HP	WOOD CUTTER MOTOR	5 HP
8	CANTEEN GRINDER MOTOR-1	1.5HP	KILN FAN COMPRESSION MOTOR	5 HP
9	CANTEEN GRINDER MOTOR-2	1.5 HP	ELEVATOR B-UNIT-1 MOTOR	3.5 HP
10	CANTEEN MOTOR PUMP	1.5 HP	ELEVATOR B-UNIT-2 MOTOR	3.5 HP
11	EXPRESSION ROLLER MOTOR	1 HP	A-PRESS SIDE WATER PUMP MOTOR	4 HP
12	A-UNIT PRESS MOTOR	15 HP	CARPENTARY PLAINING MACHINE MOTOR	3.5 HP
13	CONVEYOR TRAY MOTOR	30 HP	FITTER SHOP TOOL GRINDER	1.5 HP
14	CLAY WATER PUMP MOTOR	10 HP	SIREN MOTOR	1 HP
15	A-UNIT TRANSPORT MOTOR	1.5 HP	WELDING SET	15 HP
16	WOOD CUTTER	5 HP	HAND DRILLING MACHINE	1.5 HP
17	LIGHTING LOAD	35 HP	HAND GRINDER AND HAND CUTTER	1 HP

OBSERVATIONS

- Total load connected is 547 HP (407.898 KW)
- The maximum demand of the industry at different zones are less than the contract demand. So there is no penalty for exceeding the demand.
- Resistive Starter used for machines.
- Capacitor banks installed for PF correction are:

1. 10 KVAr (1 no.)
2. 25 KVAr (2 no.s)
3. 50 KVAr (2 no.s)

These Capacitor banks maintains the avg. PF at 0.89

FACTORY ENERGY CONSUMPTION PER MONTH

Contract demand (KVA)= 300KVA
Connected load (KW)=324.05KW
Average maximum demnd (KVA) = 203.38KVA
Average power consumption(KWh)=31158 KWh
Avg. PF = 0.89

Energy consumption (KWh)
Zone 1= 29832
Zone 2= 960
Zone 3= 1812
Total =32604 units

Energy consumption (KVArh)
Zone 1= 6120
Zone 2= 1488
Zone 3= 2908
Total =10516 units

Energy consumption (KVAh)
Zone 1= 31872
Zone 2= 1776
Zone 3= 3432
Total =37080 units

Demand (KVA)
Zone 1= 207
Zone 2= 53
Zone 3= 98
Total = 358 units

TARIFF TYPE

Diffrential pricing method

Time zone 1- normal- 6.00hrs to 18.00 hrs : Consumption X Rate

Time zone 2- peak- 18.00hrs to 22.00 hrs : Consumption X Rate X 1.5

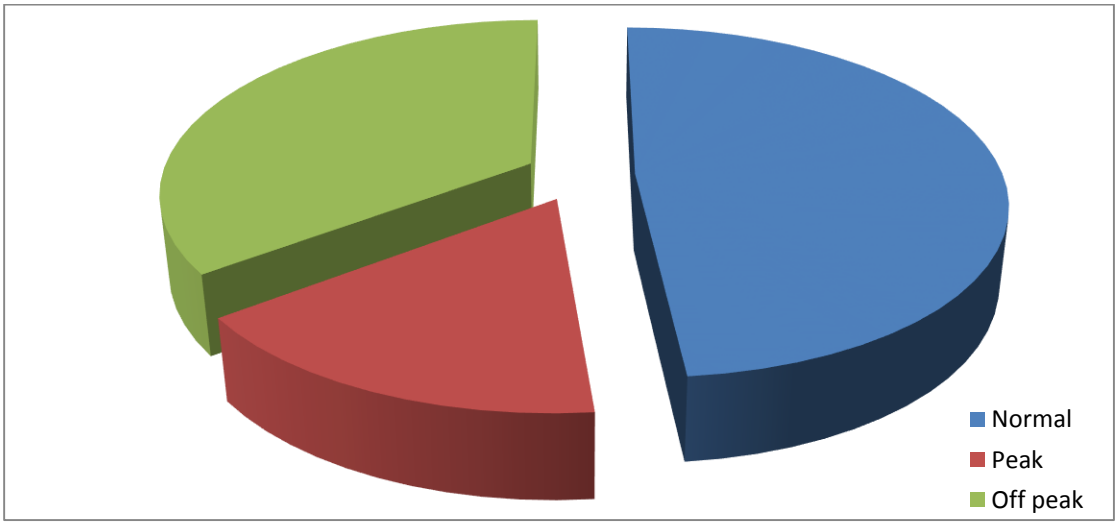
Time zone 3- off peak- 22.00hrs to 6.00 hrs : Consumption X Rate X 0.75

Total demand charge=demand charge (recorded maximum demand x rate) + excess demand charge (max of excess demand of all the three zone x 0.5 x rate)

Total Energy Charge = Rs. 173074.82

ANNUAL LOAD PATTERN

MONTH	ENERGY CONSUMPTION (KWH)			
	Normal	Peak	Off peak	Total
Jan	15625	4360	11010	30995
Feb	25570	7515	15330	48415
March	22630	7325	15370	45325
April	30615	9200	21525	61340
May	33395	11715	25630	70740
June	40680	14325	32330	87335
July	42980	14250	29545	86775
Aug	43145	15015	31735	89895
Sep	37575	14280	29834	81689



SUGGESTIONS

Most of the electrical equipment used are around 30 years old and suffers from low efficiency. Replacement of standard motors with energy efficient motors is suggested. The most energy consuming region in the industry is the kiln used for baking the tiles. The waste heat produced in the kiln can be used to generate steam using boiler. This steam can be used for meeting power requirements in the factory. Cogeneration can be employed.

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In brief suggestions are

- Use humidity dryer which will lead to uniform drying of bricks, reducing drying time and breakage.
- Effective use of waste heat.
- Instead of firewood, LPG or propane or oil can be used as fuel in order to reduce the GHG emissions and increase in thermal efficiency.
- Temperature monitoring and alarm system may be installed in kiln enabling the firemen to feed only the optimal quantity of fuel, based on the temperature distribution inside various chambers of the kiln.
- Install energy efficient motors.
- Replace incandescent lamps with CFL.
- A 100 KVAr Capacitor bank can be installed to increase the PF from 0.89 to 0.98.