

**HASSAN DAIRY, A UNIT OF HASSAN CO-OPERATIVE MILK
PRODUCERS' SOCIETIES' UNION LTD., INDUSTRIAL ESTATE,
INDUSTRIAL ESTATE, HASSAN – 573 201. KARNATKA**

UNIT PROFILE:

HASSAN DAIRY, IS A UNIT OF Hassan Co-Operative Milk producers. Union Limited registered under the Karnataka co-operative act and has been commissioned in the year 1983. The rated when constructed was 60 TKPD (Thousand Kgs per day) and was subsequently expanded to 120 TKPD by NDDDB under the turn key project in the year 2000. Dairy has under its jurisdiction 2 chilling centres and 1 mini dairy. The dairy receives milk in cans directly from dairy co-operative societies spread over in the districts of Hassan and Chickmagalore and also in tankers from chilling centres and mini dairy situated in the districts of Hassan, Chickmagalore and Kodagu. The dairy processes the milk and packs the following qualities of milk:

1. Toned milk with 3.5% Fat & 8.5% Solids not fat
2. Standardised Homogenised milk with 4.5% Fat & 8.5% Solids not fat
3. Double toned milk with 1.5% Fat & 9% Solids not fat

In addition, the following milk products are manufactured in smaller quantities:

- Ghee 38 Metric Tonnes per year
- Curd 1095 Metric Tonnes per year
- Peda 7.3 Metric Tonnes per year
- Butter milk 292 Metric Tonnes per year

The dairy markets milk and milk products under the trade name “NANDINI” which happens to be registered trade name of “Karnataka Milk Federation”, the apex institution at the state level.

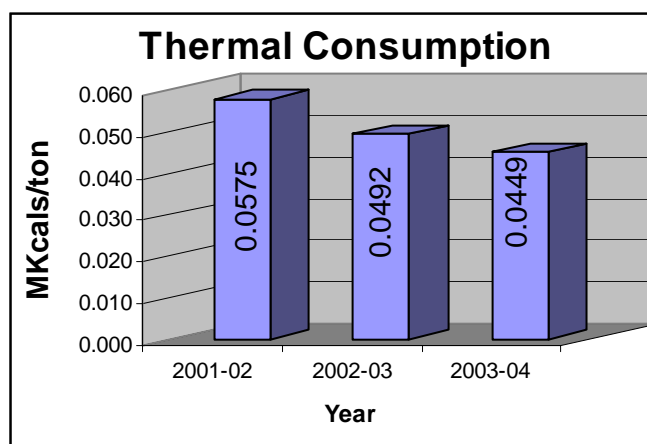
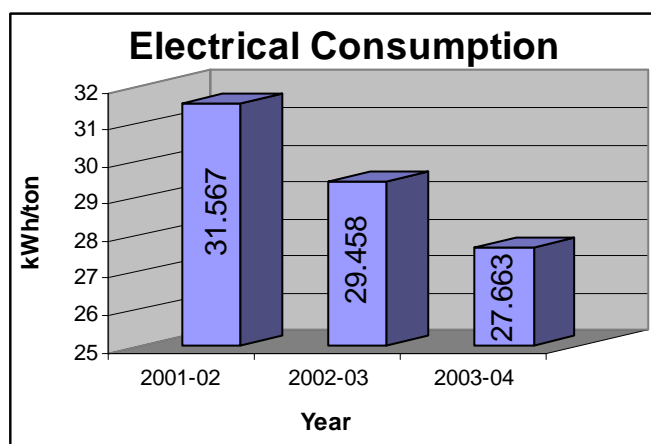
Hassan dairy is assisted both technically and financially by National Dairy Development Board, Anand, Gujarath under operation flood and vision schemes.

ENERGY CONSUMPTION:

The energy consumption in the years 2001-2002,2002-2003 and 2003-2004 along with the milk handled is as follows:

DESCRIPTION	UNIT	2001-2002	2002-2003	2003-2004
Milk Handled	Metric Tonnes	41015.86	45843.72	52107.38
Total energy cost	Rs in Lakhs	67.553	69.578	76.997
Energy cost v/s Manufacturing expenses	Percent	72.87	71.95	68.99
Total energy consumption – Electrical	Lakhs kWh	12.947	13.504	14.414
Specific energy consumption – Electrical	KWh/Tonne	31.567	29.458	27.663
Total energy consumption – Thermal	Million Kcals	2358.38	2256.90	2336.86
Specific energy consumption – Thermal	Million Kcals	0.0575	0.0492	0.0448

Year	Qty Milk Handled	Capacity Utilisation	Electrical Energy (Lakh KWHR)	Thermal Energy (MK cals)
2001-2002	41015.86	93.64	12.947	2358.38
2002-2003	45843.72	104.67	13.504	2256.90
2003-2004	52107.38	118.64	14.414	2336.86



There has been steady increase in the milk handled and decrease in the energy consumption since the dairy had launched Total Energy Management program in the year 2001 under the able guidance of NDDB, Anand, Institute Of Rural management (IRMA) with support from Karnataka Milk Federation. This program was launched in the entire state in all the 13 milk unions. In the year 2001-02 energy teams were constituted and energy managers were designated. Awareness and orientation programs were conducted to all the members of the core team by eminent faculty from IRMA, leading energy consultants in the field of Boilers,

pumps and refrigeration systems under the leadership of Prof. Haribandhu Panda of IRMA. Quarterly review meetings were conducted in the years 2001-02 & 2002-2003 wherein the teams exchanged their innovative ideas by way of presentations and discussions and also presented the achievements made under the program.

To start with the actual energy consumption was studied in comparison with the theoretical calculations made depending on the efficiency of the equipment in the dairy. The reasons for higher consumption were identified and corrective actions were initiated. This process was continued and is being continued. Thus reduction in energy consumption was achieved.

ENERGY CONSERVATION COMMITMENT, POLICY AND ORGANISATIONAL SET UP

Hassan dairy considers energy as a team approach and has included this under the “TOTAL QUALITY MANAGEMENT”

Wherein a continual approach has been bestowed to sustain the achievements made with due stress on improvement of product quality. Hence, the product quality was not sacrificed while saving energy.

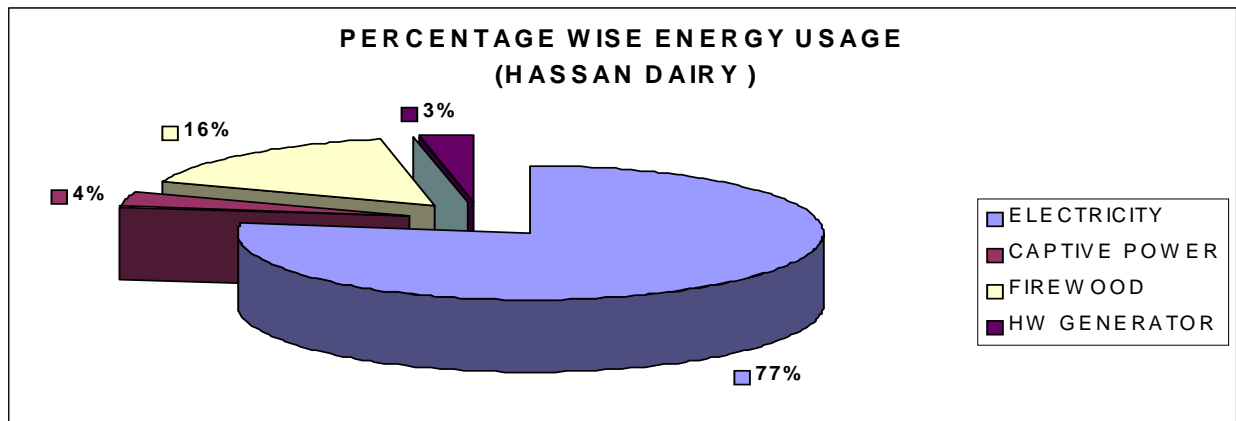
Cross functional teams were formed and the philosophy of energy conservation and quality improvement and sustainability were inculcated among all the employees by way of lectures and discussions. HRD experts were also invited to help building up of leadership qualities in the employees. The dairy also follows the 5 “S” house keeping principles with due stress on kaizen-a continual improvement. The ideas from the employees were sought, considered in achieving cost reduction and quality improvement.

The energy profile of the dairy is Electricity and fire wood mainly and also HSD is used for power generation in case of power failure and for running the hot water generator. The energy cost is 68 to 72% of the total manufacturing cost of the dairy.

The total connected load is 730 KW or 817 KVA and maximum demand is 300 KVA. There are standby motors to take over in case of breakdown or preventive maintenance.

Electricity occupies the top position in the energy profile, since 77% of the energy is generated with the help of electricity. The refrigeration section is the major user of this source of energy, wherein 70% of the total electrical energy is used by this section. Hence, major thrust was given in conserving energy in this section. This

section has 5 ammonia compressors driven by 5 nos 60 Hp motors. In addition, this section has 3 nos 10 Hp and 3 nos 5 Hp motors to run the chilled water pumps.

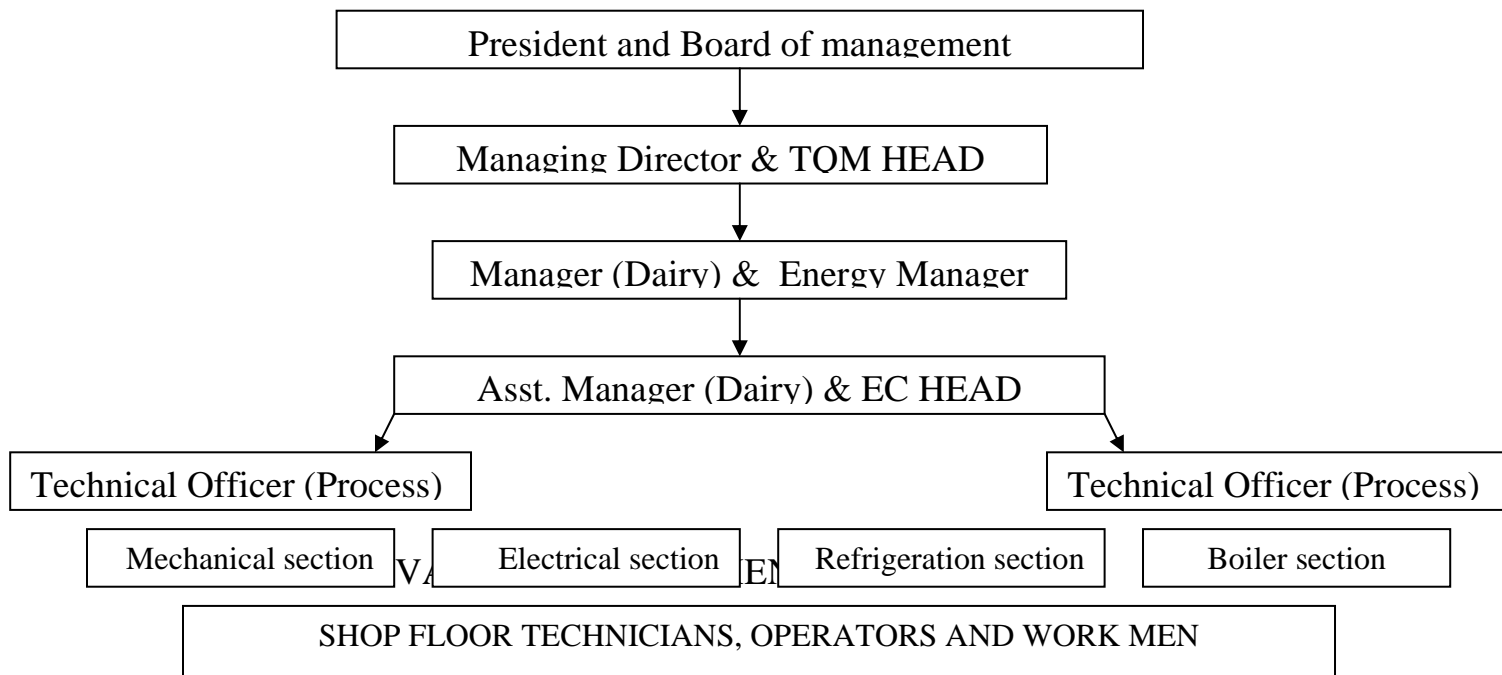


Thus, the connected load in this section 258 KW. The total running hours of ammonia compressors and chilled water pumps ranges between 18-20 hours per day. At any given point of time 3 ammonia compressors and 4 chilled water pumps will be in operation while the rest are utilised as standby.

Fire Wood is next in position in energy profile. The fire wood is purchased from the Karnataka state forest department who are very judicious in deforestation keeping in view the ecological balance. The fire wood constitutes 16% of the total energy. The major user of this energy is the milk processing section wherein more than 75% of the thermal energy is utilised. Thus this was the major section wherein the thermal energy saving efforts were put forth.

ENERGY CONSERVATION POLICY:

ORGANISATIONAL SETUP:



During 2001-2004, Hassan dairy has implemented 9 energy saving projects through engineers initiatives, sub section team suggestions and innovative ideas by officers and have achieved savings of Rs. 10.90 Lakhs with a meager investment of Rs. 4.76 Lakhs resulting in 12.37% reduction in specific electrical energy consumption and 22% in specific thermal energy consumption.

The energy saving projects implemented during 2003-04:

1. Chilled Water Management:-

➤ Initial Milk to Chilled Water Ratio	1:18.84
➤ Achieved Milk to Chilled Water Ratio	1:10.75
➤ Total quantity of milk handled	52107.304 Thousand Kgs
➤ Water pumped if ratio 1:18.84	981701 Thousand litres
➤ Electricity required	122713 kWh
➤ Water pumped when ratio reduced to 1:10.75	560153 thousand litres
➤ Electricity required	70019 kWh
➤ Electricity saved	52694 kWh
➤ Savings per annum	Rs. 2.4 Lakhs.

2. Installation of lower capacity pumps at ETP:-

❖ The requirement of electricity for a 5 Hp pump	32850 kWh/annum
❖ The electricity consumed by 3 Hp pump	19710 kWh/annum
❖ Reduction in energy consumption	13140 kWh/annum
❖ Savings per annum	Rs. 0.60 Lakh

3. Co-efficient Of Performance (COP) of ammonia compressors:- The study revealed that the COP of the system was as low as 4.5 as against the stipulated standard 5.0 fixed by the manufacturer. Reasons for the reduced COP were identified and corrective measures were implemented by which the COP improved resulting in lesser running hours of ammonia compressors. The reduction was little less than 1 hour and with this reduced running hour the total energy saved was 27704 kWh resulting in monetary saving of Rs. 1.26 Lakhs per annum.

4. Condensate Recovery:-

◆ Quantity of hot water required/day	3000 litres
◆ Delta T for hot water	57 °C

- ◆ Steam required in kgs for the above delta T 171000 Kcals
- ◆ Wood required to get 171000 Kcals
 - Efficiency of boiler 50.7%
 - GCV of wood 2359 Kcals/kg
 - Availability of calories (49.3%) 1177.77 Kcals/Kg of wood
 - Wood required 145 Kgs/day
 - Wood saved per annum 52.90 Metric Tonnes
 - Savings per annum Rs. 0.58 Lakhs

5. Installation of Boiler Chimney:-

- ✓ Qty of fire wood required to produce 6000 Kgs of steam
Before commissioning the new chimney 2772 Kgs
- ✓ Qty of fire wood required to produce 6000 Kgs of steam
after commissioning the new chimney 2655 Kgs
- ✓ Fire wood saved 117 Kgs
- ✓ Fire wood saved per annum 42.70 Metric Tonnes
- ✓ Savings per annum Rs. 0.47 Lakhs

ENERGY CONSERVATION PLANS AND TARGETS:

1. Methane Gas Utilisation:- The effluent treatment at the dairy is having anaerobic digester which produces methane gas which is being flared at present. The team intends to utilise the methane gas produced for operating 18 KVA



diesel powered generator installed at ETP (with an admixture of methane & diesel in the ratio 70:30). We had discussions with Indian Institute Of Science, Bangalore and Karnataka renewable energy development Limited (KREDEL) to obtain a safe and efficient gas kit. At present the generation of methane is sufficient to operate the generator for 10 hours/day on an average. The expected

annual savings is Rs. 1.96 Lakhs per annum with an investment of Rs. 0.50 Lakh.

2. Pre-Chiller for returned chilled water:- The temperature of the returned chilled water from process to IBT ranges between 6-8 °C. Plate type chillers can be used along with Ice bank system to reduce power consumption. The returned chilled water from the process shall be first chilled in plate type chillers instead of directly pumping to Ice bank tank using vaporised ammonia (at -10 °C) as cooling medium. The returned chilled water would be chilled atleast 4 °C and the ammonia gains heat by atleast 8 °C. Approximately a power saving of 0.3 BKW/TR can be achieved. At -2 °C the compressor can handle more quantity of ammonia delivering more capacity than at -10 °C. If a nominal 15 hrs. of operation is considered the total savings per year would be 52560 kWh resulting in saving of Rs. 239670 per annum. the proposed investment is Rs. 6 lakhs. The payback period is 2.5 years.
3. Auto Controls for Milk Pasteuriser:- The pasteurisers installed (2 nos) does not possess auto controls. Installation of auto controls would help in constantly monitoring the pasteurisation temperature. This would avoid over heating of milk, variation in throughput and additional cleaning time. In the absence of



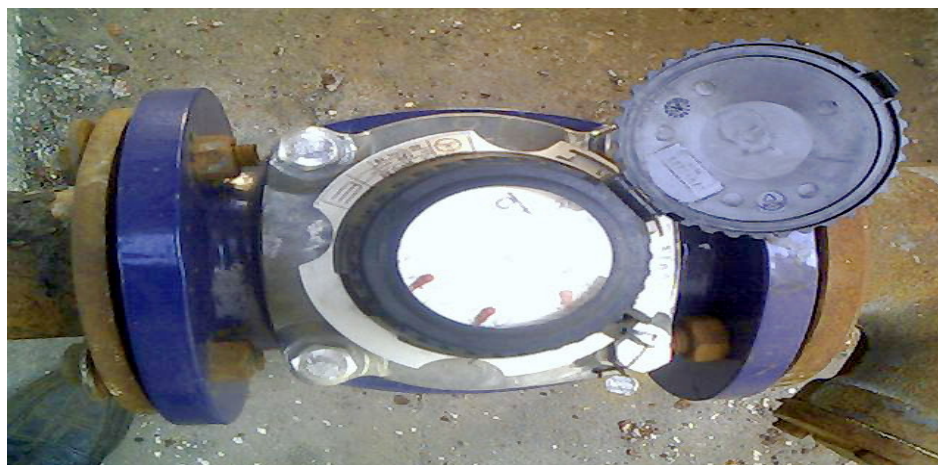
auto controls the temperature in the pasteuriser will vary between 76-82 °C thereby consuming more steam. Thus by installing the auto controls a saving of Rs. 3.75 Lakhs and the proposed investment is Rs. 3.75 Lakhs.

4. Heat Recovery Units:- Heat recovery units can be introduced in the exhaust line of ammonia and air compressors. This would reduce the load on ammonia condensers and improves cooling efficiency.

SL NO	EQUIPMENT	DISCHARGE TEMPERATURE (DEGREE C)	NO OF HRS OF OPRATION	EXPECTED YIELD OF H.W./DAY
1	BOILER	220	11	6000
2	AMMONIA COMPRESSORS	114	18	8000
3	AIR COMPRESSOR	125	8	4000
4	HOT WATER GENERATOR	235	4	2000

The expected savings per annum is Rs. 1.25 lakhs. Proposed investment is Rs. 2.5 Lakhs. Payback period is 2 years.

5. Changing of Fuel Source from Fire wood to Agriculture Waste:- The agriculture waste available in the area at a cheaper rate are coconut shell, paddy straw/husk, bagass and coffee husk. Discussions with various are on to procure briquetted fuel. The boiler manufacturers have been consulted regarding the modifications required for the existing boilers. Estimated savings is Rs. 1.5 Lakhs. Proposed investment is Rs. 5 lakhs. The payback period is 3.3 years.
6. Water Management and Rain Water Harvesting:- We intend to reduce the present milk to water ratio from 1:2.3 to 1:1.75. oppurtunities of water conservation have been enlisted and required process and layout modifications have been worked out. At present the treated waste water is



being used for gardening and for teak plantation (Around 2500 in number). Actions have been initiated to harvest rain water in consultation with the experts in the field. Initially, building top rain water and run off water is being routed to dummy bore wells to recharge the underground streams. Expected Saving is Rs. 0.17 Lakh and proposed investment is Rs. 1.0 Lakh.

ENVIRONMENT AND SAFETY:

Actions have been initiated to get the HACCP & EMS 14000 certification. The target date is by the end of 2005.

All the safety measures suggested by the statutory authorities have been implemented. There has been no incidence of accidents from past 3 years.

Summary of plant observations Hassan Dairy

1.1. Steam Generation :

A. Boiler efficiency Calculations:

A. Boiler – 1.

a. Fine gas Analysis

1	Stack dia	0.23 Mtrs
2.	Fine gas temperature	218 deg. Centigrade
3	Ambeant Temperature	38 deg Centigrade
4	Exit fine gas velocity	13.93 mts/sec
5.	Quantity of fine gas discharged	1080.27 Nm ³ /hour
6.	Suspended particulate matter	12.5 mg/Nm ³
7.	Oxides of Suplhur	4.5 mg/Nm ³
8.	Oxides of Nitrogen	6.20 mg/Nm ³
9	CO ₂ %	4 %

b. Fire wood Analysis

1	Moisture	7.49 %
2	Ash content	0.47 %
3	Net calorific value	2178 cal/gm
4	Gross calorific value	2356 cal/gm
5	Candorson carbon residue	3.98 %

c. Steam pressure : 7.5 kgs/cm²

Boiler efficiency :-

$$\frac{M_s(h_s - H_w)}{M_f \times H_f}$$

M_s = Qty of steam = 5280 kg

H_s = Enthalpy of steam = 660.2 K cal/ kg

H_w = Enthalpy of water = 38 K cal/ kg

M_f = Firewood used = 2750 kg

H_f = Gross Calorific value = 2356 K cal/kg

Boiler Efficiency = 50.7 %

Losses in fine gas:

- The dry flue gas losses was estimated to be 23.85 %

- Possible saving through excess air control = 23.85 – 8 = 15.85 %

- The possible saving in firewood considering the average fuel consumption of

2397 kg/day = 0.1585 x 2397 x 365 = 138672 kg/year

- Annual monetary savings in wood : 138672 * 1.10 = Rs. 152539.00

ENERGY BALANCE IN VARIOUS SECTIONS.

(Quantity and other parameters are on yearly average basis)

A. Reception Section:

1. Can Washer:

A	Milk received through cans	63764.0
B	Average quantity per can	33 lit
C	Total No of cans per day	1932
D	Weight of each can	7 kg
E	No of hours of operation	4.5 hour

□ **Steam:**

A. Heat required to heat the can to 70 deg. Centigrade

$$1932 \times 7 \times 0.22 \times 40 = 119011.0 \text{ Kcal/day}$$

B. Radiation loss

$$\text{Area} = 1.5 \text{ mts} \times 4 \times 3 \text{ mts} = 18 \text{ m}^2$$

$$18 \times 0.6 \times 860 = 9288 \text{ kcal/day}$$

C. Water loss :

$$\text{at } 400 \text{ lit/hour} = 45000 \text{ Kcal/day} \quad (\text{Delta T: } 25\text{C})$$

□ A+b+c :173299Kcal/day

□ Steam jetting :

$$\text{Steam used per day} = 832 \text{ kgs per day}$$

$$\text{Electricity} = 105.7 \text{ KW/hour}$$

I. Raw Milk chilling:

At 24 deg. Centigrade

Chilling load : 1423212 kcal/day

Electricity : 39.16KW/hour

Chilled water required = 191292 lit/day

II. Milk chilling (CC milk)

Capacity of the chiller (PHE) 20000 LPH

Efficiency throughput 90 %

Delta T 3 deg centigrade

Quantity of raw chilled milk Received through tankers :
42915.0 kg

Total heat to be removed : 119732 kcal/day

Chilled water required : 128745.0 lit

Electricity : 26.85 KWh

III. R C M Prepared :

Quantity of RCM : 3787.0 Kgs

Delta T 21 deg centigrade

Butter Manufacture:

- ✓ Quantity produced : 896 kg/day
- ✓ Rated capacity of butter churn : 2.0 T/hour
- ✓ No. of hours of operation : 1 hour
- ✓ Q cooling : 50950 Kcal/day
- ✓ Electricity : 15.0 KWh
- ✓

Butter melting vat ;

- Quantity of butter melted : 896 kg.
- Steam required : 100 kg/day

Ghee production & Packing :

- Quantity produced : 740 kg
- Steam required : 137 kg
- Time required per batch : 2 hour
- Electricity : 6.1 KWh

Peda Production:

- Quantity produced : 16 kgs/day
- Steam required : 100 kgs

Curd & Butter milk production :

- Electricity : 14.9 KWh

Milk packing :

- Quantity packed : 55000 lits
- Electricity : 60.0 KWh
- Air compressor & allied pump :136 Kw hr

Crate washing :

- Electricity : 88.0 KWh
- No of hrs of operation : 6.1 hrs
- Steam : 800 kgs

**OPERATION OF AMMONIA COMPRESSORS
(YEARLY AVERAGE)**

SLNO	NO OF HOURS	AVG KW (ACTUAL)	KWHR
1	3500	36.71	128485
2	2748	38.35	105385
3	2197	38.11	83507
4	3153	40.32	127128.9
5	3625	36.71	133073.7
	41.71 Hrs/day	38.02 kWh	1582.41/DAY

Sl No	Process	Electricity (Kwhr)	Steam (Kgs)	Chilling (Kcals)	Chilled water requirement (Lts)
1	Milk processing	120.80	2217	1082260	268551
2	Cream separation	36.0	-	-	-
3	Homogeniser	21.25	-	-	-
4	Cream chilling	2.2	-	66160	4962
5	C I P	7.46	737	-	-
6	Milk packing	60.0	-	-	-
7	Air compressor	136.0	-	-	-
8	Crate washer	88.0	800	-	-
	Total	471.7	4012	1.148 Megakcals	273513

Sl No	Products	Electricity	Steam	Chilling	Chilled water requirement
1	Butter making	15.0	-	50950	-
2	Butter melting	-	100	--	-
3	Ghee production & packing	6.1	137	-	-
4	Peda production	-	100	-	-
5	Curd & Butter milk production.	14.9	-	-	-
	Total	36.0	337	50950	-

Sl No	Other sections	Electricity (Kwhr)	Steam (Kgs)	Chilling (Kcals)	Chilled water requirement (Lts)
1	Refregiration section	1582.41	-	-	-
2	Cold store&condensor	181.6		281172	-
3	Boiler	78.33	307	-	-
4	Workshop	4.60	-	-	-
5	E T P	435.0	-	-	-
6	Water supply	261.0	-	-	-
6	Wash points	-	300	-	-
7	Lighting	100.68			
	TOTAL:	2643.62	607	281172	-

SECTIONWISE ENERGY USAGE :ABSTRACT:

Sl No	Particulars	Electricity	Steam	Chilling	C W
1	Reception	174.84	832	1.6169 mkcal	331397
2	Processing	471.70	4012	1.1484 mkcal	273513
3	Products	36.00	337	0.0509 mkcal	-
4	Refrigeration	1764.00	-	0.2820 mkcal	-
5	Service sections	879.60	607	-	-
	Total	3326.14	5788	3.0982 mkcal	604910

ACTUAL ENERGY PURCHASED/ UTILISED/DAY	3518KWh	6700KGS	4.090 MKcals	2148000lts
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DIFFERENCE	191.86Kwh	912 kgs	0.9918MKcals	1543090 lts
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WHY THIS DIFFERENCE ?

Electricity:

- Excessive usage of electrical energy can be attributed to
- Excessive operation of chilled water pumps which works out to **132kwh** per day
- 5000lpd homogeniser connected to 10000lph pasteuriser : **19.39kwh/day**
- Idle and part load operation of motors.

Steam :

- Loss of steam at pasteuriser battery
- Loss of hot water in crate washer.
- Line losses.
- Unnessary usage of steam at wash points.
- Faulty traps.

Refrigeration :

- ◆ Excessive operation of ammonia compressors – safety factor
- ◆ In sufficient condensor capacity
- ◆ Formation of ice blocks on coils – no thickness controller.
- ◆ Low c.o.p.

The energy saving projects implemented during 2003-04:

1. Chilled Water Management:- The sub section and the core team studied the utilisation of chilled water and found that the chilled water that is being pumped is more than required i.e. milk to chilled water ratio was 1:18.75 as against the standard of 1:5.25. Efforts were put to monitor the running of the chilled water pumps with close watch on the chilling temperature of milk. Finally the ratio was brought down to 1:10.75. The further reduction requires changes in the pipe line system. Hence, the same is targeted for 2004-05.



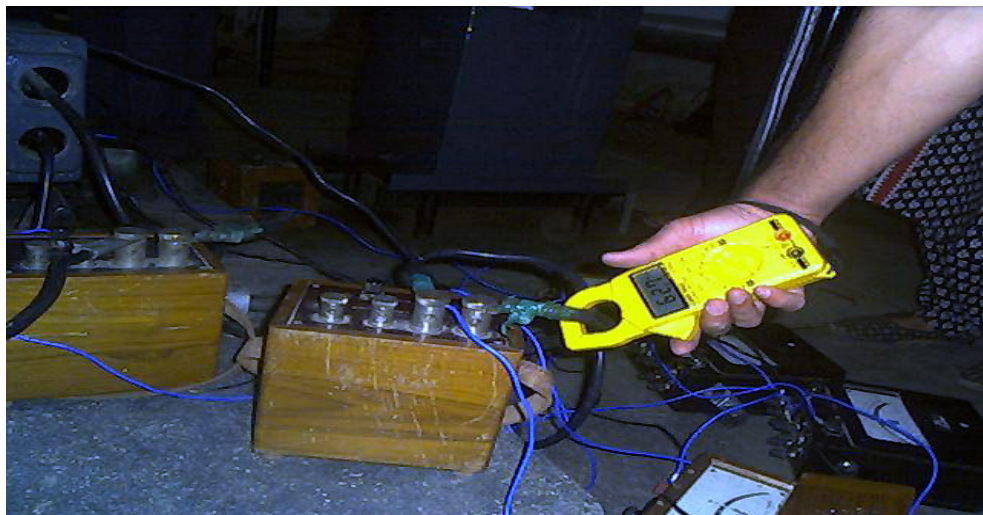
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➤ Electricity required	70019 kWh
➤ Electricity saved	52694 kWh
➤ Savings per annum	Rs. 2.4 Lakhs.

2. Installation of lower capacity pumps at ETP:- The team observed at ETP that the pumps of 5 Hp rating were partly loaded by throttling of pumps in order to feed the effluent to UASB digester continuously round the clock. After observation it was opined that lower rating pump as low as 3 Hp would suffice the needs. Thus the 5 Hp pumps were replaced with 3 Hp pumps.



- ❖ The requirement of electricity for a 5 Hp pump 32850 kWh/annum
- ❖ The electricity consumed by 3 Hp pump 19710 kWh/annum
- ❖ Reduction in energy consumption 13140 kWh/annum
- ❖ Savings per annum Rs. 0.60 Lakh

3. Co-efficient Of Performance (COP) of ammonia compressors:- The study revealed that the COP of the system was as low as 4.5 as against the stipulated standard 5.0 fixed by the manufacturer. Reasons for the reduced COP were identified and corrective measures were implemented by which the COP improved resulting in lesser running hours of ammonia compressors. The reduction was little less than 1 hour and with



this reduced running hour the total energy saved was 27704 kWh resulting in monetary saving of Rs. 1.26 Lakhs per annum.

4. Condensate Recovery:- Milk pasteurisers are the major steam consumers. The flash steam and the condensate from the hot water battery were let out to drain through the over flow pipes. Utilising old pipe lines available the condensate was re-routed to the cleaning in place tanks (CIP). The CIP requires hot water at 85 °C for washing the milk storage tanks/silos. By the above modification the requirement of steam to heat 3000 litres of water everyday was brought to zero.



◆ Quantity of hot water required/day	3000 litres
◆ Delta T for hot water	57 °C
◆ Steam required in kgs for the above delta T	171000 Kcals
◆ Wood required to get 171000 Kcals	
▪ Efficiency of boiler	50.7%
▪ GCV of wood	2359 Kcals/kg
▪ Availability of calories (49.3%)	1177.77 Kcals/Kg of wood
▪ Wood required	145 Kgs/day
▪ Wood saved per annum	52.90 Metric Tonnes
▪ Savings per annum	Rs. 0.58 Lakhs

5. Installation of Boiler Chimney:- Two 18 Mts. Boiler chimneys were installed in the year 1982. These chimneys were weak and corroded.. As installation of a new chimney was statutory the team decided to go for a common 32.5 Mts. Height chimney to harness the natural draught. This has helped in improved combustion of the fire wood, resulted in

reduction in the need of induced draught, avoided clogging of fire tubes and further improved heat transfer. To know the effect of the boiler on



wood consumption study was conducted before commissioning the new chimney and similar study was conducted after commissioning of the new chimney. The requirement of steam is around 6000 Kgs per day.

- | | |
|--|----------------|
| ✓ Qty of fire wood required to produce 6000 Kgs of steam
Before commissioning the new chimney | 2772 Kgs |
| ✓ Qty of fire wood required to produce 6000 Kgs of steam
after commissioning the new chimney | 2655 Kgs |
| ✓ Fire wood saved | 117 Kgs |
| ✓ Fire wood saved per annum
Tonnes | 42.70 Metric |
| ✓ Savings per annum | Rs. 0.47 Lakhs |