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Electrical Energy Management in the Textile Industry

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ABSTRACT

The sources and pattern of supply of electrical energy in a typical medium-scale Textile manufacturing outfit was studied over three months. The frequency of power failure from municipal supply was 408, amounting to 929.64hrs power outage. Low voltage was recorded 98times totaling 156hrs. Much of these hours were covered by in-house supply. Comparison of rated and actual power consumption/annum showed the actual higher by 115.9 %. Stand-by generators, which supplied 49.57 % of the total energy consumed/annum, guzzled 52,110 litres of diesel and 42,240 litres of heavy-duty engine oil. Added to these are the costs of personnel running the four giant generators, lost production during power-source change-overs and other salient costs. Altogether, irregular municipal power supply and energy mismanagement amounted to losses running into millions of money units.

Keywords: *Electricity, Diesel, Engine oil, Voltage, Consumption, Cost, Municipal.*

INTRODUCTION

Processing plants derive their energy from two main sources -combustion of fossil fuels to produce heat energy and electric energy.

In the textile industry, energy is used mainly to drive machine elements, light heat and cool. Some companies use electricity to achieve all that while others augment this source with fuel energy sources especially for heating and burning purposes, such as steam generation, singeing, drying, curing and other heat-assisted processes such as dyeing, printing and other finishing operations [1,2, 4].

To utilize the most viable options of energy supply, it is often instructive to carry out a comprehensive energy supply inquiry right from inception and to sustain a regular energy audit program. This should answer crucial questions like availability at plant location (e.g. municipal supply), regularity, reliability, cost; is it a constant, standard voltage? This should then be weighed against full generation of electric power requirements. Alternatively, where two sources of energy are to be utilized, it is prudent to establish the optimal mix ratios.

The ability and capacity to supply constant/regular power in Nigeria has been degenerating steadily over the years, leading to the closure of most low-medium scale outfits and the epileptic operation of others. This necessitated a closer examination of the problems caused by irregular power supply and low voltages.

MATERIALS AND METHODS

An inventory was taken of the facilities that need electricity to run – their names (type of equipment/appliance), the number in use, rated power consumption [3,5,7]. Details are as shown in Table 1.

Table 1:*Facilities available

S/No.	Machine type	Rated power consumption/hr (KWH)
1	Weaving machines x 64	62.4
2	Auto cooker	7.45
3	Weaving room light	7.64
4.	Main office and residential quarters	100.0
5.	Heater pump and hydrant pump	59.0
6.	Twisting machine	101.5
7.	Spinning room	15.8
8.	Sizing machine	18.4
9.	Mangle hot flue stenter	122.4
10.	Finishing preparation	38.5
11.	Boilers x 2	75.9

** Ratings are based on information supplied by the company. Information about models and year of manufacture are restricted as requested.*

TIME MEASURING DEVICE

A simple device was fabricated on the power supply board in the switch room. It consists of an electromagnet, a flip key, a battery and clock. On power outage, the key is disengaged by the magnet so that it bridges a circuit which starts a stop clock. When power is restored, the electromagnet attracts the key, thus breaking the clock circuit. The duration of each outage was read on the clock and are as shown in table 2.

Table 2: Frequency of power failure

Month	No. of outages	Duration (hrs)
August	156	254.88
September	130	289.75
October	122	385.01
Total	408	929.64

Table 3: Low voltage

Month	No. of outages	Duration (hrs)
August	23	81.60
September	39	12.30
October	36	62.10
Total	98	256.00

Table 4: Alternative 3-phase power supply

S/N	Generator type	Rating
1.	Dorman	187.5KVA, 400.230V, 1500rpm/50Hz
2.	Dorman	250KVA, 380/440V, 1500rpm/50Hz
3.	Dale x 2	214V, 415/250V, 1500rpm/50Hz

RESULTS

Power Supply

The factory operates 3, 8-hour shifts daily.
From records, average power consumption per 8-hr shift = 10,520.0KWhr
Assuming constant supply, the municipal source would have provided

24 x 365 = 8,760.00hrs service/year

but there was power outages and low voltage supplies which were taken care of by generators.

Therefore, total no. of hrs from municipal supply = hrs/annum - (hrs of outages + hrs of low voltage)/annum x 4 (since there are four 3-months per year):

8,760hrs - (1,085.64x4)hrs = 4,417.44hrs

This accounts for 50.43% of the total period of power requirement [4,6].

Cost of power = average power consumption/hr x 4,017.6hrs x cost /unit
= (10,520.0)/8 x 4,417.44 x 62(current price/unit) = ₦360,153,883.00 - (1)

This must be paid to the service provider.

a. If there had been constant supply throughout the year,

Cost of power $= \frac{10,520}{8} \times 8,760 \times 62 =$ ₦714,202,800.0

b. The rated power consumption of all the machines, including lighting the buildings = 608.99KWhr

For the period of supply under consideration,

Rated cost of electricity = average rated/hr x 4,017.6 x 4
608.99 x 4417.44 x 62 = ₦166,790,961.0

c. Generators

Total no. of hours put in by 4 generators/year = (period of outages + period of low voltage) x 4.
= (929.64 + 156.00) x 4 = 4,342.56 hrs

This accounts for 49.57 % of the total period of power requirement, and must be sourced from generators..

Fuel consumption/generator/8hr shift = 48 litres

At any time of power outage or low voltage, 2 generators are on-line.
Total consumption/annum = no. of hrs of supply/year x fuel consumption/generator x no. of generators.
= ((4,34256) x 48/8 x 2 = 52,110.72 litres of Diesel fuel

Cost @ ₦220/litre = ₦11,464,358.40
Average no. of services/year = 192
Volume of engine oil consumed/service = 220litres

Total volume of engine oil required/year = 220 x 192 = 42,240.0 litres

Cost @ ₦ 280/litre = ₦11,827,200.0

Direct cost of fuel + engine oil = ₦23,291,558.40 - (2)

Indirect costs/year (₦)

Labour charges	660,000.0
Spare parts	12,342,400.0
Grease (100kg)	61,680.0
Sub-Total	13,064,080.0 - - (3)

Total cost of running the generators = (2) + (3) = ₦36,355,638.40

d. If the company had engaged in full generation of its electric power requirements using generators, the estimated cost will be

Diesel consumption/shift/generator x no. of gens. in use x shifts/day x 365 = 48 x 2 x 3 x 365 = 105,120 litres and this will cost ₦23,126,400.0 - - (4)

Therefore, total cost of using generators = cost of (diesel + engine oil + indirect)

That is (4) + (11,827,200.0) + (3) = ₦ 48,017,680.0

e. The actual cost of power the company contends with is that from the municipal (1) and that of running the generators (2) + (3). i.e.

₦360,153,883.0 + ₦36,355,638.40
= ₦396,509,521
This does not include the cost of purchasing and installing the generators.

DISCUSSION

The analysis has evaluated six different costs: The rated (166.8M), the cost of power supplied by the service provider for the year (360.1M), the cost of power if the supply was regular (714.2M), the cost of running the generators as back-up (36.4M) and what it would cost the company if it chose to fully generate its power requirements (48.0M). It also calculated the actual cost by supplementing municipal supply with generators (36.4M). The actual consumption is more than twice the rated. It is about half what it would cost if the municipal supply had been regular (714.2M). This means the current tariff is too high, and can knock out most businesses. Government should, therefore, intervene in the interest of entrepreneurial vibrancy and reducing unemployment.

CONCLUSION

From the foregoing analysis, it is obvious that irregular municipal power supply is costing the company millions, in addition to production interruptions and other inconveniences.

Further, it appears there are huge energy losses along the line.

The vast differentials can be attributed to epileptic supply, machine depreciation, poor maintenance and improper attention being paid to energy management [1,2].

It is recommended that a skilled energy management unit be constituted or contracted, which should be concerned with monitoring, control and general management of energy supply and consumption. The unit should also be constantly retrained on modern energy auditing techniques and policies in order to bring the bills down to tolerable levels.

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