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ELECTRICAL ENERGY USAGE AT KONKOLA DIVISION, ZAMBIAN COPPER BELT

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ABSTRACT

This paper deals with the available statistics of electrical energy consumed at Konkola Division and attempts to highlight solutions for reducing electrical energy consumption.

The paper points out some possible methods of reducing electrical energy consumption for which further studies have to be undertaken.

INTRODUCTION

At Konkola Division, Electrical Energy accounts for 90% of the total divisional energy bill. The other forms of energy sources include petroleum products and coal.

(i) Dewatering

In the present pumping set-up clear water collects in sumps located at 350, 670 and 950 metre levels. At the bottom of each sump set-up is a pump chamber i.e. at 370, 690 and 980 metre levels respectively. Using low lifts(4 stage) water is pumped to the next sump. This is repeated until the water reaches the surface. Water at 950m is pumped to 350m using high lifts (8 stage) at 980m pump station. Water at 365m is pumped to surface using high lifts at 690m pump station. A combination of high and low lifts is used at 690m and 980m levels. At 365m only low lifts are used. On average 280 cubic metres of water is pumped to surface daily consuming about 660MWh of electrical energy.

(ii) Compressors

An average of 3.3 million cubic metres of compressed air is produced per day. This is fed directly into the supply network. About 233 MWh of electrical energy is consumed per day. The compressed air is used mainly for jack hammer drilling.

(iii) Winder (Hoisting)

Speed control is achieved by a motor - generator set.

(iv) Concentrator

Ore milling consumes 40% of the total concentrator electrical power consumption making it the largest share of all the concentrator processes.

(v) Miscellaneous

An 800 KW boiler runs 24 hours a day at the mine hospital to provide steam for laundry and sterilising purposes. The theatre has a 4 KW autoclave.

(vi) Security Lighting - Konkola Division has a total installed security lighting of over 500 KW.

POWER UTILISATION STATISTICS

The graphs from Figure 1 to Figure 7 show the electrical power statistics for Konkola Division for a period of 10 years.

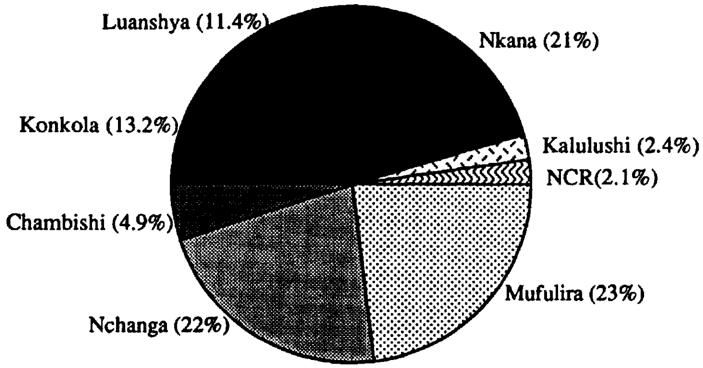
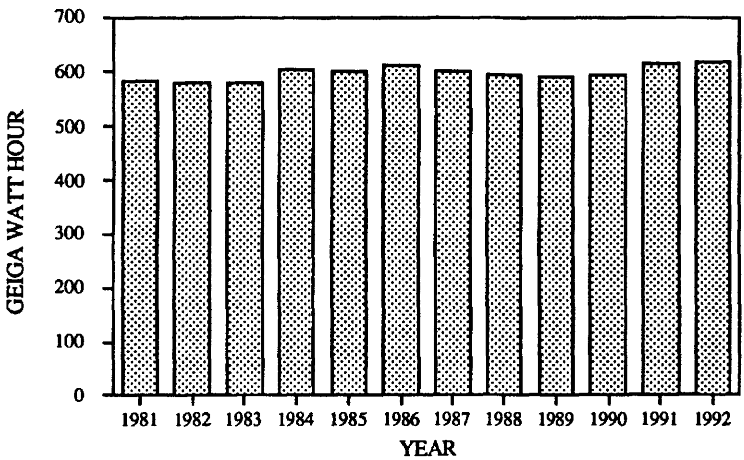


Figure 1. Copper industry power consumption - by divisions



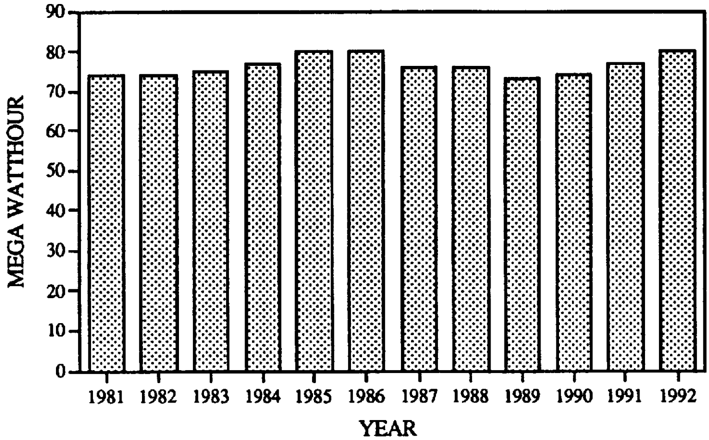


Figure 3. Annual maximum demand for electricity

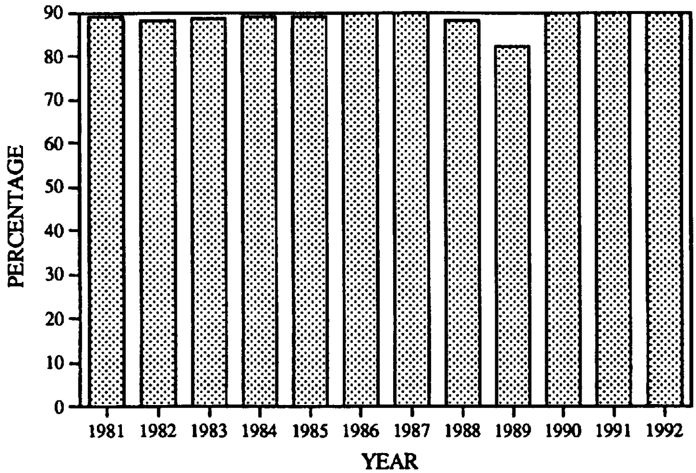


Figure 4. Annual load factor

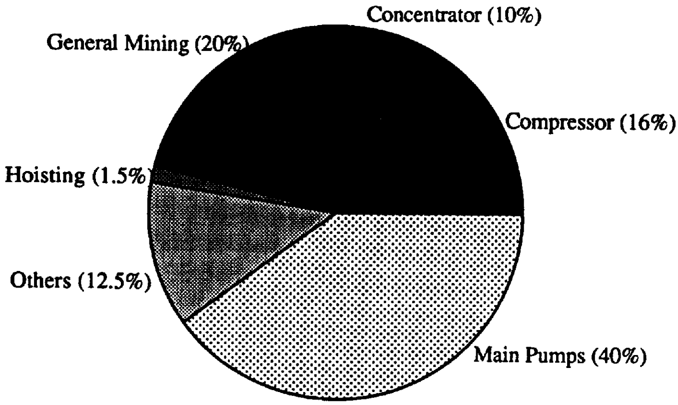


Figure 5. Electricity consumption -by loads

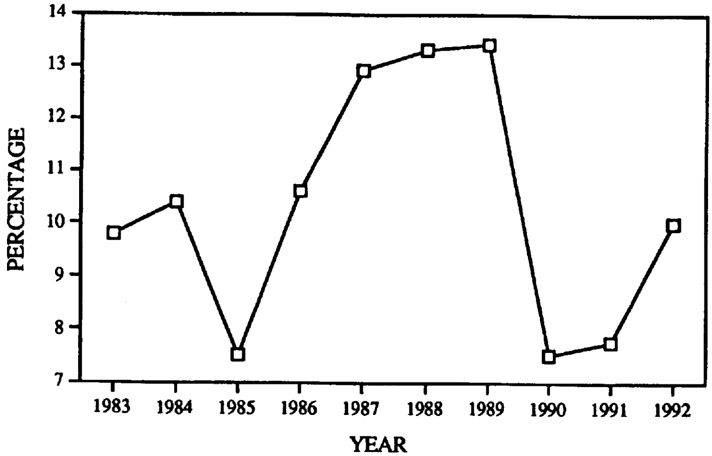


Figure 6. Annual electricity cost against annual working cost

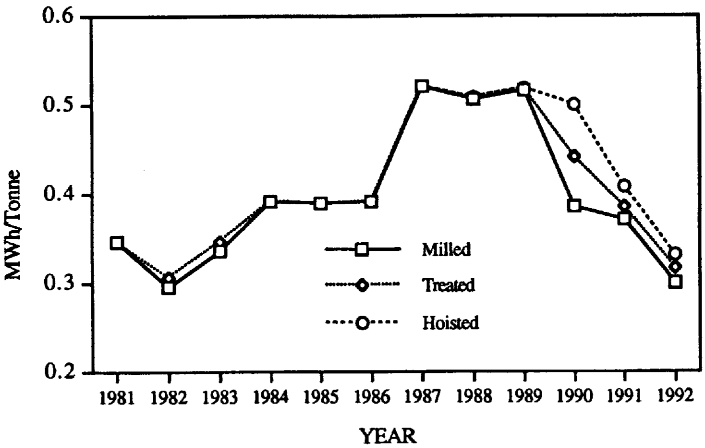


Figure 7. Electricity consumption (KW per tonne of ore)

Note:

- March - December 1989; Kafue George Hydroelectric Power Station outage. Load shedding imposed.
- 1987 - 1990; Number 3 Shaft put on care and maintenance.
- 1984; 950m Level Pump Chamber commissioned.
- 1991 - 1992; Nation - wide drought. Load shedding imposed. (Hydroelectric power constitutes 99% of electrical power generated in Zambia.)

OBSERVATIONS

The above statistics reveal the following:

- The closure of No.3 Shaft between 1986-90 was not met with significant electrical energy reduction. This indicates that our production-related power is minimal and the fixed cost of electricity is very high.
- The maximum demand control is considered good, based on the annual load factor. (However, it should be noted that the winter peak contribution to the maximum demand is 3MW due to heating loads).
- The increase in maximum demand from 1984 to 1986 can be attributed to mining at deeper depths and the commissioning of a pump chamber at 985 metre level.
- It can also be observed that a small reduction in electricity consumption will reduce the cost per tonne of ore produced.

- Any reduction in electricity consumption will assist in combating electrical energy shortages i.e during drought situations.
- Reduced dewatering activity will greatly reduce the divisional energy consumption.

PROPOSALS TO REDUCE ELECTRICAL ENERGY CONSUMPTION

(i) Pumps

- Use of single stage pumping as opposed to two stage pumping. This will mean using more of high lift pumps (8 stage) than low lift pumps (4 stage) at 685 m and 985 m levels, thus avoiding double handling of water. A power saving of 500 Kilowatts is estimated.
- Use of power factor capacitors on main pumps feeders to reduce cable losses. marginal reduction in cable losses can be obtained. Though the resistance and capacitance losses may match the gain obtained, the improved power factor will improve the overall system efficiency.
- Study the use of bore hole water at a head of 300 metres to generate electricity.
- Monitor pump efficiencies with a view of overhauling inefficient pumps. Though this can prove to be a difficult exercise, reliable methods of determining pump efficiencies exist and can be applied.

(ii) Compressors

- Reduce air leaks on the compressed air network. This could reduce compressor power consumption by 10%.
- Use more of electrohydraulic drill equipment as opposed to jack hammers.
- Install anti-surge controls on compressors and reduce on blowing off compressed air.
- Ensure drying of compressed air before distribution using refrigeration.

(iii) Winders

- Use of light weight skips with larger handling capacity.
- Replace rotary converters with static devices and increase on converter efficiency.

(iv) Misscellaneous

- Increased utilisation of underground water for domestic and industrial water supply as opposed to pumping water from Kafue river which is 8 km away.
- Uprate lighting circuits to incorporate timer controls and use energy efficient lamps. 20% of electrical energy consumption on security lighting can be saved.

- Switching-off of spare transformers and correct sizing of transformers on procurement.
- Switch-off the 800 Kilowatt hospital boiler for a period of 18 hours hence saving 75% of its present consumption.
- Use of solar energy for domestic water heating e.g change-house, hospital and homes.
- Ventilation - study mining schedule to optimise operations of both main and auxiliary fans and reduce on use of compressed air for ventilation.

CONCLUSION

It is anticipated that a saving of 2-3% of annual electrical consumption can be achieved with the implementation of these measures.

Considering that dewatering accounts for a major part of the division's electrical energy consumption, measures to facilitate significant permanent reduction in mine drainage are recommended.

ACKNOWLEDGMENTS

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