



COMMERCIALIZATION OF ZINC OXIDE VARISTORS DEVELOPED IN NIGERIA

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ABSTRACT

The possibility and economic implication of the commercialization of zinc oxide varistors developed using locally available materials in Nigeria is presented in this work. The study revealed that Nigeria has 4.63 metric tons reserve of Zinc which is the major constituents of zinc oxide varistors. The successful commercialization of these functional, protective semiconductor devices would create employment opportunity, income and wealth. The financial analysis revealed that the investment is a profitable venture with a profit ratio of 61.71% and a high rate of return of 61.61%. The investment will pay back in less than two years. The findings would stimulate and encourage entrepreneurs, government and corporate bodies that investment in this sector of the economy is rewarding.

KEYWORDS:Zinc oxide Varistors, Production, Commercialization, Financial Analysis

INTRODUCTION

The protection of Electrical installations and appliances against voltage surge is very vital for safety, reliability and durability. The use of zinc oxide varistors which provide the adequate protection margin for these industrial and domestic devices is enormous (Paul and Venugopalan,1993).The number of power and distribution transformers on electrical power system network is enormous. These transformers are of different sizes and rating. Consumer electronics, telecommunication and automobile electronics require zinc oxide varistors for surge voltage protection.

The 4.63 million metric tons reserve of zinc in Nigeria (Raw Materials Research and Development Council, 2004), can be effectively exploited for the production of zinc oxide varistor, which can be used locally and for export. The prospects and challenges for production of zinc oxide varistors in Nigeria are enormous (Evbogbai, Ajuwa and Edeko, 2011). The successful development of a zinc oxide varistor using locally available materials in Nigeria has been reported (Evbogbai, Ajuwa and Edeko,2011) ^a. The Electrical properties of the developed varistors compared favourably with that of their foreign counterpart (Evbogbai, Ajuwa and Edeko,2011) ^b. The commercialization of the developed zinc oxide varistor is expected to stimulate and promote economic development of the solid mineral sector (Khanna,2009). It will also rejuvenate economic activities in the electrical sub sector of the economy.

MATERIALS AND METHODS

Market Analysis

At present, no African country is known for the production of zinc oxide varistor. Even in the technologically advanced countries, only Japan, USA and China are known as

the major producers and exporters of varistors. This was a result of the level of technology and availability of raw materials.

The varistors market will continue to grow because new equipments will continue to be produced and the existing ones will require maintenance (Sharma and Sharma, 2010). Every electrical and electronics device requires varistor for protection against voltage surge(Chen, He and Su, 2003). It therefore means that research and development institutions, craftsmen, technician and technologist in small, medium and large scale electrical industries both local and at the international level are ready market for zinc oxide varistors.

Projected Output

For this proposal, it is assumed that the installed capacity for an average zinc oxide varistor manufacturing plant should be 200,000 units per annum. It is assumed that entry scale is 60% and full capacity will be reached in 5 years.

Required Equipment and Materials

Chemical substances used for the experiment were

1. Zinc oxide
2. Additives: Bismuth Oxide (Bi_2O_3) and Cobalt Oxide (CoO)
3. Deionized water

4. Organic binder (Starch)

Other apparatus used in the study were,

1. Electronic weighing machine
2. Electric furnace
3. Beaker
4. Stirrer
5. Rings of different diameter and thickness
6. Ball Milling (Zirconia's ball)
7. Soldering iron and lead
8. P60D and P220C waterproof silicon carbide paper
9. Pliers and knife
10. Hand gloves
11. Tongs
12. Spatula
13. Cylindrical plastic container
14. 1mm and 1.5mm copper lead
15. VD890G digital multimeter
16. Fluke model 117 True-rms digital display multimeter
17. DT2905A digital multimeter
18. AC/DC variable power supply (OMEGA TYPE LTV-005)
19. 10 Ω choke resistors
20. Gw INSTRON GDS-1062 digital storage oscilloscope
21. Farnell sine/squarewave oscillator model LF
22. FEEDBACK power circuits BEE 4210 model
23. FEEDBACK power supply 441model

Human Resources Requirement

Personnel	Number	Monthly	Annual
		Salary (N)	Salary (N)
Director	1	40,000.00	480,000.00
Production Engineer	1	35,000.00	420,000.00
Maintenance Engineer	1	35,000.00	420,000.00
Technician	2	25,000.00	600,000.00
Foreman	1	18,000.00	216,000.00
Pattern/Cast Maker	1	18,000.00	216,000.00
Accountant	1	18,000.00	216,000.00
Marketing Officer	1	18,000.00	216,000.00
Secretary/Computer Operator	1	10,000.00	120,000.00
Driver	1	10,000.00	120,000.00
Security Man	2	10,000.00	240,000.00
Cleaner	1	10,000.00	120,000.00
			3,184,000.00
Perquisites at 15% (Salary per annum)			477,600.00
		Total	3,661,600.00

Financial Aspect

(I)	Fixed Capital	Square Meters	Cost/Square Meters	Cost(N,000)
	Land and Building			
	(a) Land	1,500	1,000.00	1,500,000.00
	(b) Building			6,000,000.00
			Total	7,500,000.00

II Machinery and Equipment

	Material Description	Quantity Required	Unit Cost(N)	Total Cost(N)
1	500mL Cylindrical Polyethene Container	4	100	400
2	Stirer	4	20	80
3	Zirconia Balls	40	30	1,200.00
4	Spatula	4	25	100
5	1/2" Heavy Duty Stanless Utility Tong	1	500	500.00
6	50-1000mL Beaker(Pyrex Brand)	4	9,000.00	36,000.00
7	Hand Glooves	4	100	400.00
8	Steel Moulds(rings)	40	20	800.00
9	Electronics Weighing Machine	1	100,000.00	100,000.00
10	Electric Furnance	1	250,000.00	250,000.00
11	Soldering Iron	1	500	500.00
12	Plier	1	1,200.00	1,200.00
13	Knife	1	100	100.00
14	18KT Gold Spray	1	600.00	600.00
15	Resin Hardner	1	350.00	350.00
16	Digital Multimeter(VD890G)	1	48,000.00	48,000.00
17	Digital Multimeter(Fluke Model 117)	1	20,000.00	20,000.00
18	Digital Multimeter(DT2905A)	1	3,500.00	3,500.00
19	AC/DC Variable Power Supply(Omega Type LTV-005)	1	60,000.00	60,000.00
20	1Ohms Choke Resistor	10	100.00	1,000.00
21	Gw INSTRUK GDS-1062 digital Storage Oscilloscope	1	160,000.00	160,000.00
22	Farnell Sine Squarewave Oscillator(Model LF)	1	45,000.00	45,000.00
23	FEEDBACK Power Circuit BEE 4210 Model	1	8,000.00	8,000.00
24	FEEDBACK Power Supply 441 Model	1	22,000.00	22,000.00
25	Scaning Electron Microscope	1	15,000,000.00	15,000,000.00
26	X-Ray Diffraction Machine	1	650,000.00	650,000.00
27	Impedance Analyzer(CCS 200-Compact Spectrometer)	1	500,000.00	500,000.00
28	Generator 60kVA	1	1,500,000.00	1,500,000.00
29	Utilities and contingencies			500,000.00
	Total			18,409,650.00

(III) Raw Materials

Material Description	Quantity Required	Unit Cost(N)	Total Cost(N)
Zinc oxide	5kg	1,000.00	5,000.00
Bismuth oxide	1kg	2,000.00	2,000.00
Cobalt oxide	1kg	3,500.00	3,500.00
Cassava Starch	1kg	500.00	500.00
Deionised Water	25 Liters	2,500.00	2,500.00
Soldering Lead	2 Roll	250.00	500.00
Water Proof Silicon Carbide Paper(P60D and P220C)	20	50.00	1000.00
1mm Copper Wire	10m	50.00	500.00
18KT Gold Spray	1	600.00	600.00
Resin Hardner	2	350.00	700.00
Utilities and Contingencies			10,000.00
Total			26,800.00

(IV) Total Working Capital (N)

(a) Salaries and wages 3,661,600.00

(a) Raw materials 26,800.00

(b)	Utilities and Contingencies	200,000.00
	Total =	3,888,400.00

(V)	Total Capital Investment	(N)
(a)	Land and building	7,500,000.00
(b)	Machinery and Equipment	18,409,650.00
(c)	Total working capital	3,888,400.00
	Total =	29,798,050.00

Financial Analysis

(I)	Cost of production (Per Annum)	%	(N)
(a)	Total working capital		3,888,400.00
(b)	Depreciation on building	5%	300,000.00
(c)	Depreciation on machinery Eqpt	10%	1,840,965.00
(d)	Interest on total investment	18%	5,363,649.00
	Total =		11,393,014.00

(II) Total sale (Per Annum)

	Quantity	Unit Price	Total
		(N)	(N)
Zinc Oxide Varistor	200,000	148.75	29,750,000.00

(III)	Profitability (Per Annum)	(N)
	Total Sales	29,750,000.00
	Cost of Production	11,393,014.00
	Net Profit = Total Sales – Cost of Production	18,356,986.00

(IV)	Fixed Cost(Per Annum)	(N)
(a)	Total depreciation	2,140,965.00
(b)	Interest on total investment	5,363,649.00
(c)	Salaries and wages	3,661,600.00
(d)	40% of Utilities and contingencies	80,000.00
(e)	Miscellaneous	100,000.00
	Total =	11,346,214.00

(V)	Variable Cost (Per Annum)	(N)
(a)	Raw materials	26,800.00
(b)	60% of Utilities and contingencies	120,000.00
(c)	Miscellaneous	100,000.00
	Total =	246,800.00

$$\begin{aligned}
 \text{ProfitRatio} &= \frac{\text{Net Profit}}{\text{Total Sales}} \times 100 \\
 &= \frac{N18,356,986.00}{N29,750,000.00} \times 100
 \end{aligned}$$

$$= 61.71\%$$

$$\text{Rate of Returns} = \frac{\text{Net Profit}}{\text{Total Investment}} \times 100$$

$$= \frac{N18,356,986.00}{N29,798,050.00} \times 100$$

$$= 61.61\%$$

$$\text{Break Even Point} = \frac{\text{Fixed Cost}}{1 - \frac{\text{Variable Cost}}{\text{Total Cost}}}$$

$$= \frac{N11,346,214.00}{1 - \frac{N246,800.00}{N11,593,014.00}}$$

$$= N11,593,013.99 (N11.6m)$$

$$\text{Number of Units} = \frac{\text{Break Even}}{\text{Cost per Unit}}$$

$$= \frac{N14,414,971.43}{N148.75}$$

$$= 77,937 \text{ units}$$

Approximately 77,937 units of the zinc oxide varistors will be produced and sold before the enterprise begins to make profit.

$$\text{Pay Back Period} = \frac{\text{Total Investment}}{\text{Net Income} - \text{Depreciation}}$$

$$= \frac{N29,798,050.00}{N18,356,986.00 - N2,140,965.00}$$

$$= 1.84 \text{ years}$$

The financial analysis has shown that the investment is a profitable venture with a high rate of return and the investment will pay back in less than 2 years.

CONCLUSION

The findings of specialized research centers such as research institutes, polytechnics and universities can be translated to industrial production process for economic and social emancipation of the citizenry. The successful commercialization of the zinc oxide varistors developed using locally available materials in Nigeria would create employment opportunity, income and wealth. It will also simulate and promote economic activities in solid mineral sector, thereby diversifying our economy instead of our present state of over dependence on crude oil.

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