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# Process of Irons Smelting in Yala Local Government Area of Cross River State

Ajoma Simon Okwoche, Tawo Alfred Oyong, Inyabri Samuel Atam

Department of Archaeology and Tourism, University of Nigeria, Nsukka, Nigeria

## Email address:

jomosinee@gmail.com (A. S. Okwoche), tawoalfred@gmail.com (T. A. Oyong), samuelatam@gmail.com (I. S. Atam)

## To cite this article:

Ajoma Simon Okwoche, Tawo Alfred Oyong, Inyabri Samuel Atam. Process of Irons Smelting in Yala Local Government Area of Cross River State. *International Journal of Mineral Processing and Extractive Metallurgy*. Vol. 6, No. 1, 2021, pp. 1-5.

doi: 10.11648/j.ijmpem.20210601.11

**Received:** January 19, 2021; **Accepted:** February 18, 2021; **Published:** March 9, 2021

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**Abstract:** Iron smelting entails heating of iron at a particular temperature to enable smelter to form objects of desirable shape, Such temperature can be obtainable in a well-insulated medium size furnace, when efficient bellows and a suitable type of charcoal (and of course strong and experienced workers) are employs but some lower temperature can or may still give the satisfactory result of the time of operation is congruity, in Nigeria, especially the Yala axis the bellows used for smelting and forging iron was of rubber-tube. In Nigeria, irons smelting was said to have started from East precisely the Awka people, why inyala today we have black smelter who forges hole, knife, rake, axe, and other agricultural tools, but traditional iron smelting is gradually going to extinction where nobody is willing to learn iron smelting work, as such agricultural implement is becoming very expensive as the people of Yala continue to buy from the Ezza people who few of them are engaging in smelting. This paper therefore x-ray the processes and materials involved or used in forging. Descriptives method of data collection were employed.

**Keywords:** Black-smelter, Irons, Forging, Archaeology

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## 1. Introduction

Artifacts are the event of the fact that human activities in the particular archaeological sites, artifact gives us information of the existence of human in the past. Iron smelting has been traced it origin to the Bantu-speaking people in Africa. presently, almost every communities in Nigeria have iron smelting sites that now create jobs through heating wrought iron into or refines materials.

## 2. Method of Data Collection

The instrument used in collecting data for this study includes ethnography, fieldwork, interview, observation and descriptive. The purposes were to examine the people perspectives and to get varied information, their culture in the context of tourism through monoliths using different method in other to help analyze the data properly. Descriptive design is one in which information is collected without changing the environment, that is nothing is manipulated, it is used to obtained information concerning current status of the

phenomena to described, what exist with respect to variables or condition. the method involves ranging from the survey which describes the status quo, the correlation study, which investigates the relationship between variables, to developmental studies which seek to determine changes overtime [1]

## 3. Result of the Finding

### 3.1. Raw Materials Used

Metal sheet, galvanized pipe angle iron bellow water, fire wood chisel, hammer, shears, grinder, hacksaw, tree-trunk, iron bar, iron bar arc or welding, file or grinder, brush and paint etc.

### 3.2. Quality and Particle of Charcoal

Bullock [2], in his work titled *primitive iron smelting in South Africa*, charcoal, the reducing agent in the smelting process, must be carefully selected uniformity, hardness, burning speed, particle size is characteristic that has a

decisive influence on the outcome of the smelting

He says that Bavenda felled those trees for charcoal burning which were otherwise of no use to them. However, other tribes were probably selective in their choice of wood for charcoal burning.

Kusel noted that the water berry, the cape beech (*Rapanea melanophloeos*) and the wild seniga (*Burkea Africana*) were used to obtain charcoal [6, 7]. But here in *Yala* wood or charcoal are obtained from exotic hardwood especially mahogany and the local wood called *ogah* (hardest wood) from the bush is obtained in the quantities required either falling the wood yourself or through bush burning, the wood may fell [8].



Figure 1. Equipment used by the smelter.

**3.2.1. Bellow and Air Supply**

The African smelter and smiths regarded bellows as the most important factor in their work. In many parts of Africa, the iron-smelting process was just called blowing the bellows and competent smiths were referred to as “men skill in bellow” [9-11].

In Nigeria, especially the Yala axis the bellows used for smelting and forging iron was of rubber-tube but in other parts of Africa, goat skins were generally employed for the bellow while in some report antelope skin was mention especially the skin of the sable antelope.



Figure 2. Bellowing.

The volume of air produced by skins bellow or (rubber

tube) and delivered to the smelting furnace depend on a number of factors.

Size of bellow (2) Diameter of the nozzle (3) Dimension of the tuyeres (4) size of the air gap at the nozzle-tuyere connection (5) pumping rate of the bellows.

**3.2.2. Temperature**

Temperature is the degree of hotness of the place the temperature is ranging from 1150 -1250°C. Such temperature can be obtainable in well-insulated medium size furnaces when efficient bellows and a suitable type of charcoal (and of course strong and experienced workers) are employs but some lower temperature can or may still give the satisfactory result of the time of operation is congruity.



Figure 3. Firing.



Figure 4. Forging.

According to the black smelter [8] the temperature required for a black smelter to know if it is ready is by the colour when it changes to red and green-blue he further highlights that colour is important it indicates the temperature and workability of the metal as the piece of iron heat to the higher temperature, it first shows red then orange as and finally yellow, but most smiths use the ideal of yellow-orange that indicate forging because they must be seeing the glowing colour of the metal the lighting must be consistent.

### 3.2.3. Basic Method Use by Forges

1. Drawing: is done by either chuck or charcoal to get the size of the exact materials before chiseling out the pieces. It can be done with a variety of tools and methods, the most used method is hammering on the anvil horn and hammering on the anvil face using the cross peen of a hammer. Another method is by using fuller.
2. Bending: Heating iron to a forging heat allows bending as if it were soft, ductile metal, like copper or silver. Bending can be done either by hammering over the horn or edge of the anvil or by inserting a bending fork into the handy hole placing the work pieces between the tines of the fork and bending the materials to desired angle.
3. Punching: Punching, is done to create a decorative pattern, or to make a hole e.g in preparation to make a hammer head, a smiths would punch a hole in a heavy bar or rod for the hammer handles punching is not limited to depression and holes. It also includes (involves) cutting, slitting, and drifting with a chisel.
4. Welding: this is the joining of the same or similar kind of metal in forge welding, the pieces to joined are heated to what is generally refers to as welding heat. The metal glows an intensive yellow or white at this temperature the steel is near molten.

Before welding or joining the smelter first of all clean the surface that is joining together with a wire brush then put them in a fire to heat with the mixture of drawing and upsetting the smith shapes the face so that when brought together the center of the weld connects and spread outward pushing the flux upsetting. A blacksmith is a metal smith who create object from wrought iron or steel by forging the metal, using the tool to hammer, bend, and cut. Blacksmith produce objects like grilles, railings light-fictions furniture, sculpture, tools, agricultural implement, decoration, and religious items, cooking utensils, and weapons.

### 3.3. Control of Smelting Process

The amount of air injected into the furnace was unknown, but the temperature radiation colour observed through the tuyere covering the hole bored through a furnace wall the colour of the flames were also observed playing on the top of the fire-bed-blue luminous flames indicating a satisfactory reducing atmosphere and the feel of the heated furnace walls for the heat distribution in the furnace. Ore and charcoal was added at a proper time, thus maintaining the required condition in the furnace [12-15].

#### 3.3.1. Smelting Operation

Iron smelting process include a number of operational factors which I will mention few of them. This include the firing time, charging sequence of the furnace with one and fuel and the method of discharging bloom and slag. H. M. Friede et al observed a number of experiments and the influence of top temperature on the yield and quantities of iron evaluated [3-5]. It was thought that low temperature

(900-1000°C) maintained for a reasonable time would favour the reduction-oxidation balance. He further say the best results were obtain by use of familiar high temperature (100-1200°C) for short periods, especially at the end of the firing provided a reduce atmosphere was maintained at all time. During the run-process, large clay shreds were placed loosely over the furnace top to protect the fire-bed from the wind.

#### 3.3.2. Forging

Forging take place when the smelter notices that the iron has been heated to a particular temperature that enables him molde into a desirable shape, traditional smelter uses hammer for forging of an object of any size and shape, See figure 5 and 6 below.



Figure 5. Forging process.

## 4. Manufacturing Process (Product)

Blacksmith work by heating pieces of wrought iron or steel until the metal becomes soft enough for shaping with hand tools such as hammer, anvil, and chisel. Heating is done fueled by propane or charcoal.

The hoe and traps are the most manufacturing tools. This is because it is highly utilized in all facets of the agricultural calendar and has a low life span. Then also repaired pieces of equipment like machetes, pruning, raffia knife, wedge, flint, sieve, trident chisel, art knife, hammer, awl, door, scraper, anvil, iron hook, axe, pickaxe, kitchen knife, needle, shovel, rake, sickle, skimmer, trident hoe.



Figure 6. Smelter fixing the hole.



*Figure 7. Finished product.*

#### 4.1. Marketing

The marketing of the finished product is done by moving the materials produced to the final consumer or the end-users. According to the smelter [8] the peak period of the marketing is between (March-August) and much of the product that is most needed by this period is a hoe for planting. And during the dry season period trap is the most sell materials between the month (December- March). Although sometimes on demand the customer who requests on-demand does come and buy at the industry or site where the product is made.



*Figure 8. Materials in their weekly market.*

#### 4.2. Challenges

During bellowing since it is manual, it is very difficult to

pump continuously since it cause arm string (pains in the hand) also hammering and chiseling of the metal into desirable shape is another major challenge. And lastly, transportation to market is another key issue. It is always seasonal.

## 5. Conclusion and Recommendations

From my finding and study, it is seen that there are few forges. But forging in this part of Nigeria especially Yala is going to extinction. The smelter [8] sees it as an extension (only come back from the farm) before doing the smelting process. All the materials mentioned above are useful to society. And I advise that the smelter should also put more interest so as to learn the modern method of iron smelting and different types of forges so as to earn him more income, but not to put food on his table alone. Since he has made it an extension of his work, I also recommend that he should also employed or look for apprentice so that smelting as an ingenious knowledge will not die when he is old (aged). Lastly, I recommend further study.

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