



Technological Innovations Designed to Save Time and Physical Labour in Masaga Indigenous Glass Bead Making

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ABSTRACT

The Masaga glass bead makers' employ the furnace wound technique in the bead making process. This process has been found to be experiencing a furnace operational problem, that is, the air supply to the furnace which constitutes a critical aspect of the entire glass bead making operation has to be supplied by the instrumentality of manually operated cloth bellows often times by a supporting apprentice. The operating manpower for this craft, as has been observed to be the case with other similar local crafts, is depleting leading to the plodding extinction of this trade. Deriving from an appraisal of the work practice of glass bead making craft in foreign locations as in India, Ghana and Egypt that use local furnaces, the study developed an appropriate design and the fabrication of an electrically-operated centrifugal fan to replace the laborious hand-operated cloth bellows. The design and fabrication of a centrifugal fan to supply compressed air to aid combustion and the design modification of the Masaga glass bead making furnace worked successfully in operation resulting in an increased capacity and consistency of air supply leading to the speed-up of the bead making process. On operation, it was possible to achieve the working temperature of 1200°C within the space of twenty (20) minutes. The bead making process using the furnace-wound technique can now be carried on without depending on an assistant to supply compressed air needed for combustion. The results of the study show that furnace modification as well as the deployment of the centrifugal fan to glass bead making provide the much needed solution to arrest the decline in the trade as well as boost economic activities in the trade.

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INTRODUCTION

Glass bead making is a craft, which has become a viable part of the culture of the Nupe indigenes of Masaga in Niger State of Nigeria and it occupies a place among the local indigenous industries in Nigeria. Ige (2006) reported that previously two centres in Nigeria were actively engaged in the glass bead making craft – the Ife centre and the Bida centre; presently, however, there are no

indications that the Ife centre is active and the Bida centre, having persisted for long has not shown any sign of further development but rather a diminution in activities. The glass bead making industry in Nigeria, among some others identified by Essien (2011) such as traditional soap making, blacksmithing, fishing, wood carving, traditional medicine, weaving/dyeing, calabash carving, small scale farming, brewing and distilling, and

pottery, is on the verge of extinction. One major reason attributable to the state of decline in the glass bead industry in Nigeria is the fact that the craft has remained the same in terms of its tools and operational routine which involves a number of participants, who are mostly associated by consanguinity, with the younger members having to work the manual bellows without which the whole operation becomes unfeasible. The changing socio-economic order in the country coupled with rural-to-urban migration result into the younger ones opting for either higher education or alternative vocation, which take them away from the glass bead making craft, the consequence manifesting in the decline in glass bead making activities and an impending total collapse of the industry.

According to Affum (2009) the glass bead makers of Ghana, particularly those of the Krobo people, make use of clay moulds, which help them make many beads within a shorter time than it would take to make the same by the furnace wound technique of the Masaga glass bead Guild of Bida; their furnace also does not have need for manually worked bellows as is the case with the Masaga bead makers of Nigeria. This makes their work easier with less labour input and hence less overall cost; it is also an

enterprise that a single individual can take up and sustain without the help of any assistant, which means that the work can be carried out efficiently and will not be stranded due to the absence of a helping hand. According to Osec (2012) reports, the products of the Ghanaian glass bead makers appear to enjoy greater export market and greater online presence coupled with wider circulation than their Masaga counterparts.

The design of the glass bead making furnace has remained practically unchanged since the craft was established among the Nupe bead makers of Masaga (See Plates I, IIa & IIb). The furnace is contrived in such a manner that compressed air for combustion has to be supplied by means of manual cloth bellows, which must be operated by an assistant all through the process of glass bead making. This implies that if there is no assistant to work the bellows, the whole operation of the glass bead making will be impossible. Secondly, the fact that a minimum of two people are involved in the process of glass bead making, makes the glass articles relatively more expensive than they should be since each individual involved in the bead making process is entitled to some form of commission on each item produced and sold.



Plate I: Masaga Glass bead making Furnace in operation. *Source: Alemaka (2009)*



Plates IIa: Cloth Bellows
Source: Alemaka (2009)



Plate IIb: Manual working of Bellows
Source: Alemaka (2009)

Proffering a Solution to the Identified Problem

The solution to the problem identified with respect to the bead making process lies in reducing the number of hands involved in the process and this will require that a self-sustaining combustion process for the furnace be put in place. To actualize this, an electrically powered centrifugal fan was designed to supply compressed air to the furnace in order to sustain combustion in place of the manually operated cloth bellows.

CHOICE OF FAN

The choice of the centrifugal axial fan with flat blades for this particular study is made on the basis of the following factors, which are considered as advantages by the Energy Efficiency Guide for Industry in Asia (2006); the centrifugal axial fan with flat blades is suitable for high static pressures and high temperatures; it is a simple design; it can operate at low air flows without vibration problems; it has high durability; it has efficiencies up to 75%; and it has large running clearances.

FAN DESIGN CONSIDERATIONS

The fan to be designed is the centrifugal radial blade type and certain parameters are considered which include

the quantity Q of gas (in this case, air) to be delivered by the fan and the head H which must be developed to overcome the resistance to the flow of the quantity Q in the connected system (McGraw-Hill 2002). These operating conditions establish the fan dimensions of diameter D and rotational speed N . The load placed on the fan must also correspond to a condition on its operating characteristic.

METHODS AND MATERIALS

The working methods employed in this study are design, design drawing, fabrication, assembling, welding and painting.

The materials employed for the centrifugal fan are:

1. Steel sheets
2. Steel circular pipes
3. One Atlas® Electric Motor with the following specifications - 0.74kilowatt, 1Hp, 50Hz, 1440rpm
4. One four-blade impeller
5. Two (2) pieces of 1ft diameter circular metal sheets
6. One (1) 0.25inch radius metal elbow pipe
7. Metal angle bars
8. One (1) connecting metal shaft
9. Elbow connecting pipe

Furnace Design Modification

In order for the Masaga bead making furnace to accommodate an electrically-powered centrifugal fan, the furnace

design was modified and resulting furnace is presented in Plate III (Alemaka, 2014).



Plate III: Modified Furnace structure
Source: Alemaka (2014)

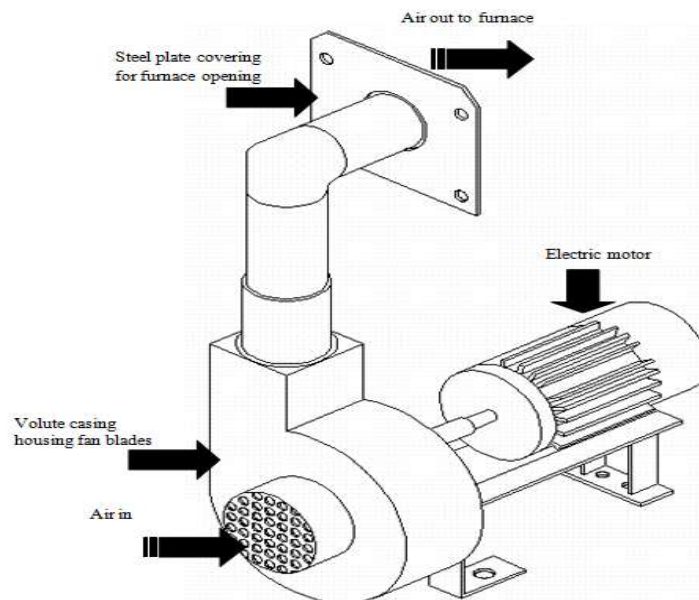


Figure 1: Isometric Projection of Centrifugal Fan

Fabrication of the Fan

The electric motor of the stated specification was purchased from a local dealer (see Plate IV)



Plate IV: Electric motor

Subsequently the four-blade impeller was fabricated; this was achieved by measuring and cutting out the individual blades necessary to form

the impeller. This was now welded and attached to ball bearing which was now attached to a metal shaft by a screw (See Plate V).



Plate V: 4-blade Impeller attached to shaft

Subsequently, the port (also known as fan housing or volute) which is to house the blade was cut out from metal sheets and

coupled together by welding (see Plate VI).



Plate VI: Volute casing (Impeller port)

Next the 'elbow' pipe, (See Plate VII) which is necessary to direct the air being generated by the blade to the

furnace opening was attached to the port by welding;



Plate VII: Estimating Elbow welding height

The assembly was now attached to the electric motor and the height necessary to reach the furnace opening was gauged. Having measured out the correct height positioning of the 'elbow'

pipe to the opening of the furnace, the whole device was now coupled by welding and subsequently painted (See Plate IIX).



Plate IIX: Complete Centrifugal Fan coupled with electric motor

The fan design was evaluated against the factors identified by Edward (1995) as cited in Oyelami *et. al.*, (2008), and was found to be good. The fan was checked for vibration, by ensuring that there was no material build-up on the wheel, loose mounting setscrews, bearings, bolts, or couplings, misalignment or excessive wear of belts coupling or bearings, bent shaft, material build-up on the wheel, excessive system pressure or restriction of airflow due to closed dampers, inadequate structural support or mounting, and externally transmitted vibration.

RESULTS

Furnace Temperature Attained

The completed fan was coupled with the modified furnace as pictured in Plate IX. A test run was carried out by operating the set up and the fan was observed to have effectively supplied forceful air which sustained combustion in the furnace and thus performed the function of the manually operated cloth bellows of the Masaga glass bead furnace. The fan was observed to operate just perfectly, supplying combustion air at an appreciable pressure increasing the rate of combustion of the charcoal and consequently increasing the heat output and invariably the temperature of the furnace.



Plate IX: Centrifugal Fan coupled with Modified furnace structure

Within twenty minutes of forceful combustion air supply, a deep orange-to-white fire was attained in the furnace, this fire coincides with the temperature range of about 1,100 to 1,200°C (Maggio, 2011), which is

adequate for any glass-bead working process (See Plate X). The test-fired glass sample was observed to have successfully softened enough for manipulation (see Plate XI)



Plate X: Deep orange-to-white flame attained in furnace



Plate XI: Sample of glass softened by furnace heat

CONCLUSION

Prior to this study, there was no known record of any attempt to introduce any form of technology for the enhancement of glass bead production in

Nigeria. The techniques and materials for glass bead production, as far as the Masaga Glass Bead Makers' Guild of Bida, Niger state is concerned, has remained the same for several years as far as one



can possibly remember. The Firozabad (Glass City of India) is a success story which illustrates the potentials that abound in glass bead making and as such provides us with a paradigm from which we can draw inspiration as well as the much needed impetus to invest in the local glass bead making industry in Nigeria (Firozabad Glass City of India n.d).

This study, which is aimed at the introduction of the centrifugal fan as an alternative to the manually worked bellows of the Masaga glass bead making furnace, is a significant step in the right direction. The results of the study show that furnace modification as well as the deployment of the centrifugal fan to glass bead making provide the much needed solution to arrest the decline in the trade as well as boost economic activities in the trade. The successful adoption of this centrifugal fan by craftsmen of the Masaga glass bead guild in their work will guarantee less labour input, which translates into less cost of production and hence a reduction in the current exorbitant sales price of the items per unit, which also means that prospective buyers will find them more affordable for patronage. Furthermore, with the adoption of the centrifugal fan for the supply of combustion air to the furnace, the young boys who normally work the bellows will be free to pursue education at whatever level they so desire and since they will normally return home during vacation, they would still be able to engage in the craft of glass bead making.

REFERENCES

- Affum M.A (2009): *Beads in the Krobo Culture*; (Unpublished Master's Thesis) submitted to the School of Graduate Studies, Kwame Nkrumah University of Science and Technology, Kumasi pg. 10
- Alemaka E.M. (2009): *Report of Field trip to the Masaga Glass Bead works in Bida, Niger State* submitted to Department of Industrial Design, Ahmadu Bello University, Zaria.
- Alemaka E.M. (2014): *Design Modification and Construction of a Glass bead making Furnace*, Seminar presented at the Faculty of Environmental Design, Ahmadu Bello University, Zaria.
- Energy Efficiency Guide for Industry in Asia (2006): *Thermal Energy Equipment: Furnaces and Refractories*; (Chapter – Furnaces and Refractories.pdf) retrieved from www.energyefficiencyasia.org
- Essien C.F (2011): *Empowering Indigenous Industries for National Development: A Review*; Journal of Research in National Development JORIND (Vol. 9 No. 1 pg 13) June 2011
- Firozabad Glass City of India (n.d): *An Introduction – The Glass City of India – Firozabad* Retrieved November 11, 2014 from <https://sites.google.com/cite/rajatresponsible/>
- Maggio M. (2011): *Fire II Colour and Temperature* retrieved September 13, 2014 from <http://maggimaggio.com/color/2011/08/fire-ii-color-and-temperature/>
- Mc-Graw-Hill (2002): *Fans*; McGraw-Hill Encyclopedia of Science and Technology (9th Edition) Vol. 7 pg 12 published by McGraw-Hill Inc.
- Osec (2012): *New Markets, New Opportunities; The Brass and Bead Jewellery Industry in the Republic of Ghana*; Swiss Import Promotion Programme Stampfenbachstrasse 85 CH-8006 Zurich.
- Oyelami, A.T., Olaniyan, O.O., Iliya, D., and Idowu, A.S., (2008): *The Design of a Closed-Type-Impeller Blower for a 500kg Capacity Rotary Furnace*; Assumption University Journal of Technology, 12(1) pp50-56