

Feasibility of Copper Recovery through Cable Stripping at Agbogbloshie

September 2012

1.0 Introduction

Agbogbloshie, the nerve centre of electronic waste ‘recycling’ in Ghana, has a rather poor and an infamous image from its phenomenal pollution that afflicts the population of part of the capital city of Ghana, Accra. The major source of the polluting activity is cable (plastic sheath) burning to recover Copper wire. Green Advocacy Ghana (GreenAd), the Blacksmith Institute and other partners have collaborated to help improve the hazardous working conditions of the electronic-scrap handlers, and to avoid the environmental pollution problem and public health exposure risk to southern Accra. The collaboration led to a number of studies (country assessment of e-waste (mass flow), socio-economic impact, heavy metal exposure (human and environment), etc), sensitization and awareness creation, as well as international exposure to best practices in e-scrap recycling.



Fig.1 Sections at Agbogbloshie (pile of Monitors (Left), floating CPUs (Middle) and a working Child (Left))

The cable burning at Agbogbloshie and its impacts remain a real threat. The outcome of series meetings with the Greater Accra Scrap Dealers Association (GASDA) on possible ways of eliminating the Copper wire recovery-associated burning eventually pointed to the application of some form of economic mechanism. The preferred mechanism favoured purchasing all obtainable raw cables, in order to make the material unavailable. That meant however, the need to explore an alternative recovery method to burning, such as the use of wire strippers. Second, the alternative method needed to be feasible technologically and economically, and also acceptable to the people. Third, there would be the need for a system to run the purchasing of raw cables, and producing and selling the clean Copper.

2.0 Background

In March 2012 a team from the Blacksmith Institute and Hunter College CUNY collaborated with GreenAd to introduce a variety of wire stripping technologies and techniques to train and transfer the technology to the e-scrap workers at Agbogbloshie. Five e-scrap workers/burners were initially trained and then extended to some 50 “wire strippers/burners” field testing the equipment. This was followed by another round of training offered to over 200 e-scrap workers by GreenAd, the Raw Materials Group and Partners.

The trials with several stripping tools and methods led to selection of a set of feasible stripping tools. The results were highly favourable. All indications were that some of the hand-held and simple mechanical wire stripping technologies were feasible and acceptable to

the workers at Agbogbloshie. This completed the first level of the overall goal of introducing an environmentally sound alternative to burning for Copper wire recovery.

3.0 Objectives

This phase constituted the second level towards the goal of introducing an environmentally sound alternative for Copper wire recovery. The study was intended to quantify the economic feasibility (in terms of time and financial benefits) of using wire strippers to release the plastic from the copper cables, as opposed to the environmentally damaging burning process as currently practiced.

4.0 Methodology

The methodologies for the two processes of Copper recovery using hand operated (manual) wire stripping tools and using fire and burning of the cable plastic sheath are described below. The results of the two methods are evaluated and compared in terms of time and financial advantages (without considering the obvious environmental damage by burning).

4.1 Agbogbloshie Dump Yard

The study was conducted at the Agbogbloshie Scrap Yard in Accra, in the Greater Accra Region of Ghana. Agbogbloshie is located on the left bank of the Odaw River, on the upper reaches of the Korle Lagoon in the southern part of Accra.

The Agbogbloshie site started as a food stuff market particularly for onions and yam, but no sooner did the status change as scrap recycling activities starting thriving. The scrap dealers discovering the place as a good location for business started to erect temporary stalls and sheds to house their wares and activities. The National Youth Authority (NYA) - the then National Youth Council - owners of the land was approached by the scrap dealers for a portion of the land for the scrap industry. The dealers later registered with the Registrar of Companies in Ghana as the Greater Accra Scrap Dealers Association (GASDA) of Ghana, and the land leased to them in 1994 by the NYA.

Over the years Agbogbloshie has grown into a large slum with people dealing in all kinds of scrap, and a dumping ground for old electrical and electronic products as well as household waste. The scrap yard has developed into an infamous but popular recycling area, where tons of e-waste ends up daily as a final resting place. These are broken apart and/or burned to salvage copper and other metal components and materials for sale. Currently, Agbogbloshie stands out as the hub of the informal 'recycling' industry in Ghana.

4.2 The people

A large proportion of the people in Agbogbloshie engaged in scrap activities come mainly from the Northern Regions of Ghana, from the Savelugu, Tamale and Bimbilla areas.

Six (6) experienced e-scrap workers/burners were selected from members of the GASDA at the Agbogbloshie site, after an initial briefing session (a day earlier) on the objectives of the

research. These were among the people who had been trained in March and April 2012 on the use stripping equipment. These six were divided into two teams: Team S was the Stripping Team; and Team B was the Burning Team. Each team comprised of three members. The objective was to ensure a near equal effort by the two teams. Table 1 below provides demographic information as well as age and years of experience of the team members who participated in the study.

Table 1: Information on Participants (Demography, Age and Years of Experience)

Participant ID	Age	Hometown	Years of Experience
1	32	Bimbilla	8
2	21	Savelugu	3
3	28	Pong Tamale	5
1	25	Kpalong	5
2	22	Tamale	6
3	22	Savelugu	6

4.3 Technology and Materials Used

The equipment and tools used for the stripping activities included the following:

- Knives - 2
- Blades - 2
- Automatic Stripper 1
- Cranker Stripper 1
- Green Stripper 2
- Rollers - 1
- Boards - 1
- Red and Black Cutter 1
- Red and Black Pliers 1
- Tables - 3

The equipment or fuel used for setting the fire and burning included the following:

- Styrofoam;
- Matches; and
- Water (in containers/sachets)

The cable materials consisted of thin wires, coiled wires, transformer wires and others of various sizes. The sources of these materials included ICT equipment, old vehicles, telecommunication equipment and other household electrical cables. The materials (cables) were obtained or purchased on the site from third parties (i.e. those who bought them from the collectors/scavengers) by team members, who were given cash for the purpose. The targeted daily quantity for treatment by the two teams was 80lbs (i.e. 40kg/day).

Weighing scales were needed for weighing the raw cables before and after processing to enable the various comparisons to be made. Since these scales are available at various selling points on-site at Agboglobshie, belonging to metal buyers, it was not necessary to obtain one specifically for the pilot exercise. The analogue scales were however, always approximated and did not provide high accurate weighed materials in decimals.

4.4 The Treatment Processes

The 80Ib-weight of cables purchased were mixed up, divided and weighed using an on-site scale and apportioned into two equal parts, taking into account similar cable types and sizes for the two teams. The Stripping Team set up stripping tools - strippers, cutters, crankers, knives and blades on the working tables, etc. and got organized in position for the work. The Burning Team purchased boxes of matches, water in sachets and went around organizing some Styrofoam substances on the dump site that formed the fuel for burning and got the fire set. The stripping and burning activities were carried out at different locations on the site.

The two teams commenced their respective operations (cable stripping and cable burning) at the same time (at about 9.00am), processing a batch of 40Ibs of identical cables each. Two researchers supervised the teams to record the working time and conditions and to ensure independent work (with no form of support from friends), as well as generally observing and making notes.

At the end of processing, the Stripping Team collected the clean Copper wires into a container and the plastic sheath swept into a waste bin. The Burning Team used a pole to assemble the hot Copper wires from the burning spot and sprayed the hot Copper with water to cool it down. The process of burning, dragging the hot Copper and cooling with water makes the Copper wires pick other substances and become dirty. The dirty Copper wires were transferred into a container and taken away. Both sets of products (clean and dirty Copper) were weighed using a scale on-site (at one of the selling points) belonging to a metal buyer. This was one of the many on-site processed metal buying businesses. Selling of the daily output was immediate, with the stripped Copper always attracted a premium rate.

The process was repeated for 7 other days. Only the results of days 3 to 8 were used in the analyses. This was because of inadequate materials used during the first two days due to artificial scarcity, and the decision to consider the work on those starting days as trials.

5.0 Results of Analysis

5.1 Material Output by Teams

At the end of the research, different parameters such as, recovered Copper, weight loss (difference in weight), processing time, sale price, etc. resulting from the two Copper recovery methods were analyzed. Tables 1 and 2 below show the cable weight before and after processing, the weight loss (weight of plastic sheath) and the sale price for the Copper from both processing methods.

Table 2: Summary of Cable Stripping Variables

Day	Quantity of Material (Ib)	Processed Weight (Ib)	Loss in Weight (Ib)	Sale Price (GHS)	Processing Time (Mins)
1	30	21	9	113.40	120
2	40	29	11	145.80	200
3	40	31	9	167.40	185
4	40	32	8	172.80	178
5	40	30	10	162.00	198
6	40	31	9	167.40	159
7	40	31	9	167.40	189
8	40	32	8	172.80	201
Total	240	187	53	1,009	1,110
Average	40	31.2	8.8	168.20	185

Table 2 shows that on the average 75% of processed Cu is recovered from the cables. In other words, the weight of the plastic sheath around the Cu wire, which is lost (as waste) when the stripping method is used constituted 25% on the average. The average sale price of 40Ib raw cables or 31.2Ib processed cables (recovered by stripping) is GHS168.20.

Table 3: Summary of Cable Burning Variables

Day	Quantity of Material (Ib)	Processed Weight (Ib)	Weight Difference (Ib)	Sale Price GHS	Processing Time (Mins)
1	30	15	15	75.00	10
2	44	33	11	165.00	09
3	40	28	12	140.00	11
4	40	30	10	150.00	08
5	40	29	11	145.00	09
6	40	27	13	135.00	09
7	40	28	12	140.00	12
8	40	27	13	135.00	11
Total	240	169	71	845	60
Average	40	28.2	11.8	140.80	10

Table 3 shows that using the burning method recovers about 64.2% of Cu on the average from the copper cables. This gives a weight difference of about 35.8% (as weight lost). The

average sale price of 40Ib raw cables or 28.2Ib processed cables (through burning) is about GHS140.80

Tables 4, 5 and 6 provide a comparison of the weight of Copper recovered, the processing time and selling price by stripping and burning methods respectively.

Table 4: Comparison of Weight of Copper after Processing

Day	Weight Before Processing (Ib)	Cable Stripping for Copper		Cable Burning for Copper		Weight Difference (Ib)
		Weight After Stripping (Ib)	% of Cu Recovered	Weight After Burning (Ib)	% of Cu Recovered	
1	30	21	70.0%	15	50.0%	6
2	36	27	75.0%	33	75.0%	(6)
3	40	31	77.5%	28	70.0%	3
4	40	32	80.0%	30	75.0%	2
5	40	30	75.0%	29	72.5%	1
6	40	31	77.5%	27	67.5%	4
7	40	31	77.5%	28	70.0%	3
8	40	32	82.0%	27	67.5%	5

The difference in weight of recovered Cu is 3Ib more for processing of 40Ib of cables by stripping than through burning on the average. Whereas the burnt copper lost as much as 30% of its weight after burning, the plastic in the stripped accounted for 25% of the original cable weight.

5.2 Re-Sale Value of Clean and Dirty Copper

Table 5: Sale Price Comparison

Day	Copper from Stripping		Copper from Burning		Difference in Price	% Difference
	Copper Recovered (Ib)	Sale Price (GHS)	Copper Recovered (Ib)	Sale Price (GHS)		
1	21	113.4	15	75.0	38.4	33.9
2	27	145.8	33	165.0	(20.8)	12.6
3	31	167.4	28	140.0	27.4	16.4
4	32	172.8	30	150.0	22.8	13.2

5	30	162.0	29	145.0	17.0	10.5
6	31	167.4	27	135.0	32.4	19.4
7	31	167.4	28	140.0	27.4	16.4
8	32	172.8	27	135.0	37.8	21.9
Total	187	1,009	169	845	164.8	
Average	31.2	168.2	28.2	140.8	27.5	

For every pound of burnt copper which is sold for Gh5.00, the stripped copper sells for between Gh5.10 – 5.40 depending on where it is sold. The factories in Tema, we were informed may even pay better than Gh5.40 for stripped copper.

5.3 Comparison of Processing Time for Stripping and Burning of Copper Cable

The average time spent by the Stripping Team in processing the 40Ib copper cables was 2.38 hours as compared to 9.88 minutes achieved by the Burning Team. In view however, of the environmentally damaging and pollution effects of burning, cable burning to recover Copper is not an option.

Table 6: Processing Time Comparison in Minutes

Day	Cable Stripping (Minutes)	Cable Burning (Minutes)	Difference in Time	% Difference
1	120	10	110	91.7
2	200	09	191	95.5
3	185	11	174	94.1
4	178	08	170	95.5
5	198	09	189	95.5
6	159	09	150	94.3
7	189	12	177	93.7
8	201	11	190	94.5
Total	1,110	60	1,050	567.6
Average	185	10	175	94.6

5.4 Assessment of Technologies Applied

Some tools used were considered suitable while a few others turned out to be less appropriate. Below is an assessment of the different technologies used.

a) Board (channel) Stripper

The board or channel technology was very good for the processing of the very tiny cables. There were wider channels for bigger cables but the workers preferred using other technologies when stripping the bigger size cables. A recycler can however make good progress using this technology assuming there is a good and sharp blade. The unfavourable aspect of this technology is its time consuming nature. Most workers would rather burn the small cables than ‘waste’ the time stripping them to recover the copper. However, further training and awareness can go a long way to change the perceptions. A quote from a worker at the site aptly described their concern. *Mohammed A. Mohammed: “This is a very good idea but very slow. I am not sure my people would be willing to waste all the time stripping”*

b) Razor Stripper

When used alone, the razor technology did not offer much in terms of the ability to strip large quantities of the cables available at Agbogbloshe. The reason could be because participants were not familiar with its use and had not the patience to practice and get the necessary speed.

c) Hand Stripper

The hand strippers were portable and gave an individual the opportunity to work alone unlike other technologies where a recycler might require the help of another to operate. But most of the hand strippers turned out to be slow and not ideal for processing large quantities. Participants gave the strippers low marks. But the Automatic Hand Stripper was quite popular among the participants.



Fig.2 *Hand Stripper (Left) and the Stripping Team in Action (Right)*

d) Crank Stripper

The crank stripper was the most efficient and popular technology. Initially, like all the others, was difficult to use but as the participants got used to it, they were able to strip larger quantities with it. It was used in stripping almost all types of cables during, except for the very tiny types. Alidu Barake (an Elder at Agbogbloshe) had this to say: *“Very good ideas but get us a motorized cranker which is bigger; we would be willing to contribute and pay for it”*



Fig.3 Cranker on a Table (Left) and Workers using Cranker to Strip a Cable (Right)

e) Roller Stripper

The roller was most useful in stripping long cable of medium to large dimension. It was very comfortable when used for a cable of more than 2 meters in length and about 6mm and above. The downside is that it was only good for stripping such wires and remained mainly less useful in the absence of such types.

6.0 Discussion

The average time for processing 40Ib cables using the two methods took 10 minutes and 185 minutes for cable burning and cable stripping respectively, involving three experienced.

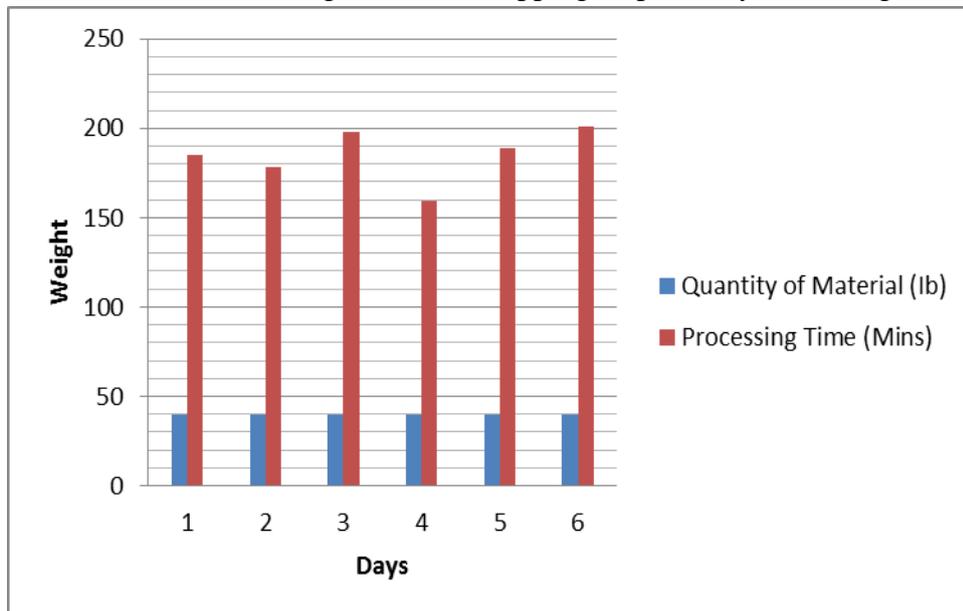


Fig.4 Materials Processed Per Batch and Time Spent (minutes)

Thus, a single worker will be expected to spend an average time of 30 minutes and 493.3 minutes respectively burning and stripping a 40Ib bundle of copper cables.

The time spent by the team engaged in the burning of copper cables is just 3.35% of the time spent by the team stripping the same quantity of cables over an 8-hour day.

From the above, the most efficient method is the burning of copper cables as an individual would be able to 'recycle' a 44.58lb bundle of cable in just about 30 minutes and make about GhC222.90 within that time frame.

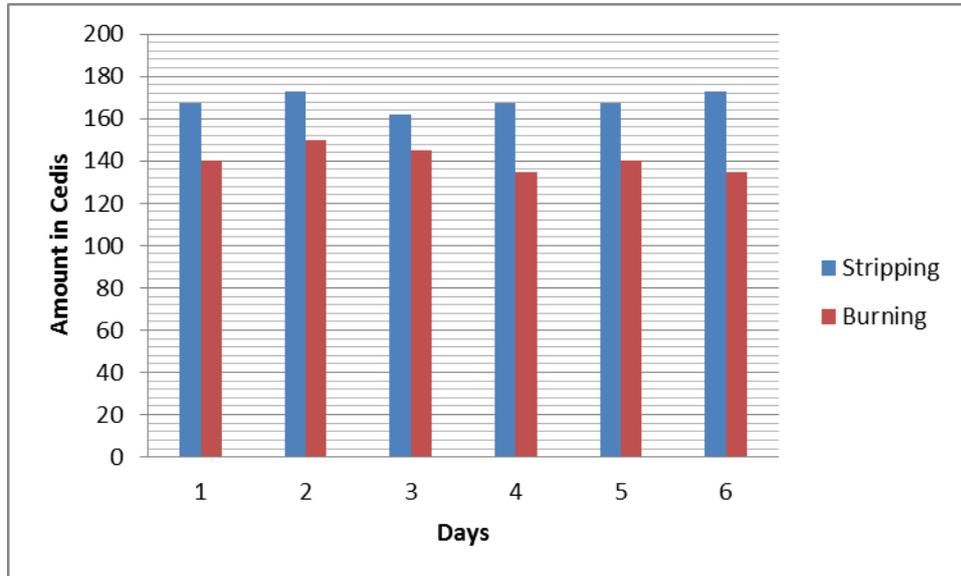


Fig.5 Comparison of Sales Price for Burnt and Stripped Copper

A cable stripper would achieve that same weight in a time of 493.3 minutes but earn GhC17.83 more. GhS0.4 is not enough an incentive to keep exploring this option. Best way would be to buy the cables at source and process ensuring that no worker gets the opportunity to burn while others are stripping.

In the future, it will be very difficult to buy cable from the scrap workers with the intention of stripping as there is currently no agreement on how to discount the weight of the cables as against that of the actual realized copper at the end.

Buyers can be categorized into two groups; onsite and off-site buyers. The onsite buyers are those who operate at Agbogbloshie. The off-site buyers are the ones in the factories as well as those who do bulk buying. Premium rate for clean stripped copper is what the bulk buyers who are mostly found off-site are willing to pay. The onsite buyers also pay a little more than what they pay for the burnt copper, about Gh0.4 more. Yes, they are very willing to pay more and offered to do so. How it works: they just pay a bit more when clean stripped copper is offered to them.

7.0 Recommendations

There is obviously the need for further studies which will serve as continuation of this one. Bigger and faster technologies/equipment possibly automated must be purchased to enhance the stripping process and also the affection of the scrap workers. A faster and more efficient technology would be embraced by the majority because most of them agree that the burning of cables is not the best solution. The willingness of both members and the executives of

GASDA are available to the project as long as they feel their interest is greatly thought about. Additional training would be necessary in changing their perceptions, attitudes and practices.

The following recommendations are made with the view to helping in improving the operations at Agbogbloshie and also in helping direct further research there.

1. The study confirmed the view that the stripped copper commands a better sale price due to its quality than the burnt and sold at a premium rate of about Gh0.40/lb more.
2. The current technologies applied in the stripping process; cranks, cutters, blades, etc. are very slow. During the study, while the burning team was usually finished within a quarter of an hour, the fastest the stripping team could achieve was 2 hours for the same weight of copper cables. It is recommended that the technology should be improved possibly to include the use of a motor to power a bigger crank.
3. There should be a concerted effort to raise the level of awareness already created among the workers on the benefits of using new and improved technologies towards retrieving copper than what they already know and are used to.
4. Further training is necessary in the application of the various stripping technologies.

Important lessons learnt; whatever the direction will be at Agbogbloshie, the beneficiaries will be the scrap workers and thus what they think should be seriously considered to give any next steps the opportunity of taking root and bringing about the needed changes at Agbogbloshie.

Mallam Yusuf (Vice Chairman of GASDA): “.....at this stage, it is important for capital investment especially towards the purchase of cables, processing, and subsequent sales to ensure that the situation is run as a business.”

Mohammed A. Mohammed: “This is a very good idea but very slow. I am not sure my people would be willing to waste all the time stripping”

Alidu Barake (an Elder at Agbogbloshie): “Very good ideas but get us a motorized cranker which is bigger, we would be willing to contribute and pay for it”

Appendix A – Extra Charts – Analyses of Data

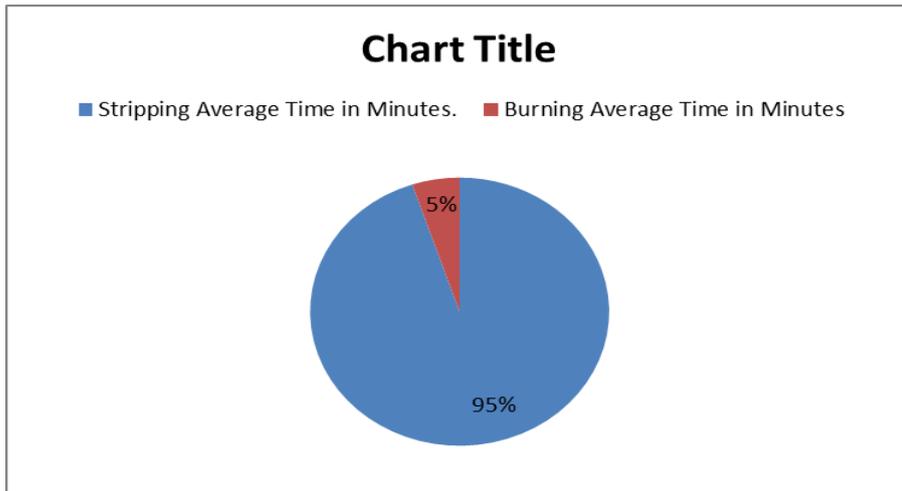


Fig.6 Comparison of Time Spent in Stripping or Burning of Cables

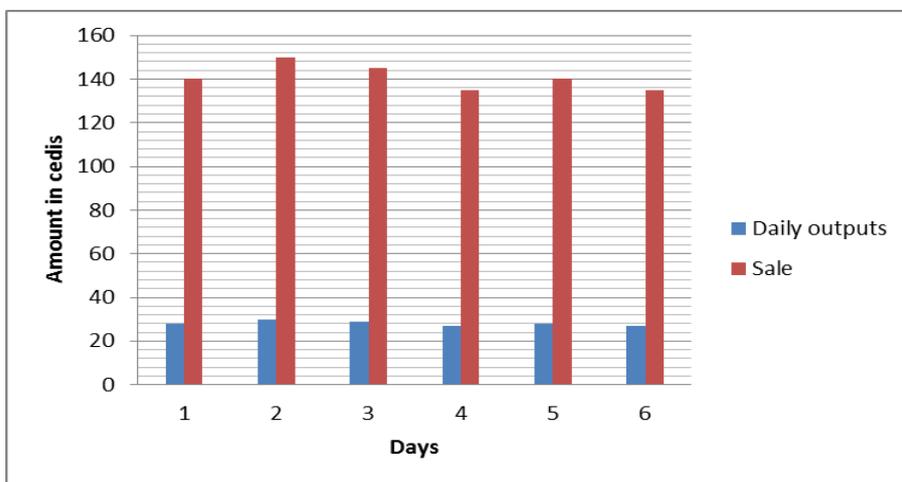


Fig.7 Sale Price of Stripped Clean Copper

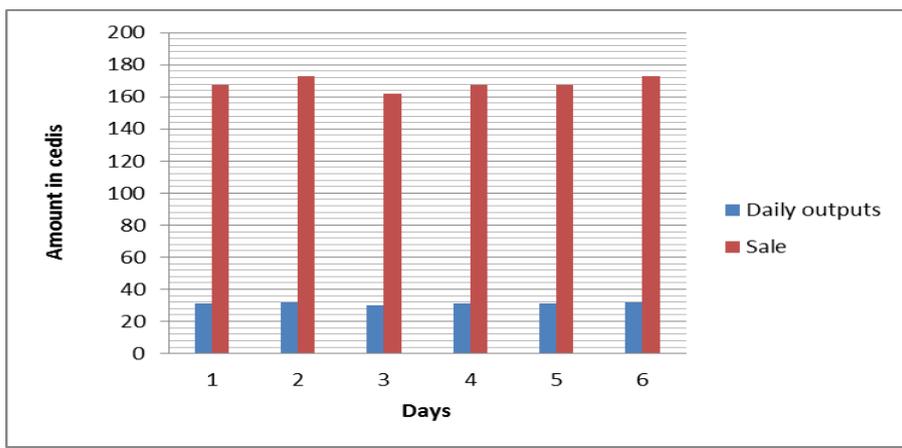


Fig.8 *Sale Price of Burnt Copper*

Feasibility of Copper Recovery through Cable Stripping at Agboglobhie