THE DESIGN AND CONSTRUCTION OF 'AZ FISHER'

By

R.A. Osemenam
Federal University of Technology,
Akure, Ondo State

ABSTRACT

The need to look inward for an alternate type of fisher that will have minimal operational problem to our own local condition has motivated the author to embark on the design and construction of a fisher using locally sourced raw materials. The design and construction entail the calculation of geometrical shapes of needed materials and the use o basic engineering construction procedures such as welding, machining etc. This ultimately led to the production of 'AZ FISHER' that is not only a useful material in the drilling industry but also of a relatively low unit cost when compared with the existing fisher in the market.

INTRODUCTION

Fishing is the removal of fallen objects from a borehole after or during boring or drilling. The object, which may be drilling rod, drill bit or riser pipe is referred to as a fish while the fishing tool as a fisher. Arlov (1999) on study of fishing tools in the mining industries gave historically three main fishing tools and their limitations. These fishers include the simplest, the hook, followed by threaded heads, hook cap, and magnetic head fisher. He noted that the simplest fisher, the fishing hook does not have a wide range of use and works by chance. The threaded head fisher is very labour intensive and the conical head if not fit unto the casing could be a stumbling block rather than what it intended to do and even when it fits, it makes the rotation more difficult to achieve. The conical head tends to expand when load is applied to it thereby increasing the friction between it and casing wall. Also, at deep depths, except when an attempt is to recover a bit, the cost of recovering is more than what is to be recovered. For the case of the hooking cap it can only pick vertically standing pipes and picked objects are permanently indented due to the gripping mechanism. Ershov (1999) on evaluation of fishing tool in the mining industry pointed out that fishing is a demanding and tedious activity as failure of drill bits renders the hole useless. He went further to state that in order to prevent this all available means should be sought to retrieve any lost of the drill machine component from the hole. Anistratov (2000) on limitations of existing types of fishers stated that various fishers have been designed but not without limitations. He went further to state that all existing fishers take advantage of the dimensions of the lost item; added to this, the casing material could also be a deciding factor. For example, in a steel cased hole, if not properly directed, a magnetic head fisher will not function properly as the casing will interfere with the generated magnetic flux. It could even prevent the descent or lowering of the fisher. Anderson (2000) confirmed that in the mining industry one of the paramount problems associated with drilling is the collapse of riser pipes and any lost material during and after drilling into the hole is referred to as **fish.**

Since the fisher known is not without a problem in our local condition it becomes necessary to look inward for an alternative type of fisher that might have minimal problem and relatively low cost. This has motivated the author to research on the design and construction of a fisher that may be suitable to our own local conditions.

2. MATERIALS AND METHOD

The locally produced fisher is made up of the followings:

- The house or body
- The shoulders
- The cap
- The, fist, ears, fingers and springs and spring housing.

2.1 The house or body: The material used for the house or body is steel. I has lower end tapered at 45^o to create a sharp edge necessary for the "knocking" action. This sharp edge is achieved by the use of electric hand grinding machine. Figures 1 to 5 show the design/construction scheme.

2.2. The shoulders: In the design, the desired length was obtained from simple truncated cone calculations shown in figure 6. The base diameter is the external diameter of the fisher body and is approximately 22 cm, and the height 14 cm. The width did not occupy more than 70% of the circumference of the body. There is a gap between the shoulders that provide the escape route for water so that the acceleration of the fisher down the hold will not loose momentum.

2.3. The cap: This is made of flat plate of 5mm thickness. With a shoulder diameter of 7cm the cap's diameter is increased by 1cm. to 8cm, so that the loaded cap will absolve the expansion at the bent end of the shoulder's top. Holes of 2mm in diameter were drilled as shown in figs. 7 to 10. The bent shoulder tip has holes of 9mm drilled in to fit into the cap. The holes at the other end fit into counter sunk holes of the fisher's body.

2.4 The palms: There are two palms. They were constructed by cutting a galvanized pipe of thickness 4mm and diameter 7cm. a length of 8cm. was cut. This piece was sliced into three. Two pieces were taken and the ends smoothened. The edge to carry the load was hardened. The two pieces were then expanded away from the circular curve to form a hyperbola. They face each other. Figures 11 to 13 show the outline scheme of design and construction of the palms.

2.5. The arm: This is a centering rod of diameter 25mm. It was threaded at both ends to fit into the cap and fist. It carries the fist. Figures 14 and 15 show the design/construction scheme.

2.6. The ears: They serve as points of attachment for draw ropes. They are made of steel rods of diameter 5mm (figs. 16 and 17). They are welded to the inside of the upper 50mm of the body.

2.7. The fingers: There are three in numbers. They were made of hardened steel whose posterior ends are rounded with drilled hole of 9mm. The rounded end is of radius 7mm. The other end was flattened with a thickness of 4mm. They were sprung as the palms. The diameter of the hold or space formed between the fingers was not less than the diameter of the fish, fig. 18.

2.8. The springs and spring housing: These are accommodated on the fingers and the palms. The one on then palm was of internal diameter of 17mm. and the ones on each finger were of 11mm of internal diameter. The length of each housing is 10mm. A slit was created on each housing. There was determination of spring constant using the principles of Hook's law.

RESULTS AND DISCUSSION

Table 1 showed the data obtained during the determination of the spring constant of the spring on the palms using Robert Hook's law of elasticity. Fig. 19 is the graph of load against the extension to actually determine the spring constant of which value was deduced to be 1 kg/cm. here the length of spring for palms and fingers were deduced as 65mm and 50mm respectively. The constant for inger spring gave 0.25kg/cm.

The finished fisher (AZ- FISHER) loaded on the cap is allowed to freely fall into the hole. The amount of the load depends on the depth of acceleration to the head of the fish, the weight of the fish, the smoothness of the wall and the type of material the casing is made up. The lower the depth of the hole, the higher the momentum that can be gained by, the falling fisher. This however depends on the frictional effect or the resistance exerted by the walls of the casing. Since it is expected that the fish would lean on the casing, the heavier the fish the higher the force needed to knock it off the wall. The needed load can then be easily deduced or calculated. The smoother the wall, the less the acceleration force, since the rougher the wall, the more the frictional effects or resistance. It should be noted that for the same level of roughness, fish weight and smoothness of wall, the amount of load used on a p. v.c. cased wall will not be the same as that used on a steel cased wall in order to prevent wall collapse since p.v.c.'s are of less yield strength than any steel.

For the attachment of the ropes, three short pipes higher than the shoulders and cap should be used. Alternatively, rods higher than the cap should be attached then the ropes are in turn attached to the rods. The attachment should be at the ears. The rods should be of high yield strength. If ropes are attached directly to the ears, they will rob against cap making them vulnerable to failure. An advantage of using the connecting rods is that it allows for the use of only one rope. The use of three ropes necessitates clipping of ropes at intervals.

On the overall, the entire working action of the AZ-FISHER depends on three stages. The first is the knocking stage, where the fisher accelerates down the hole and knocks off the socket o the fallen line from the casing. The second is known as the centering stage. Here the falling of the fisher, after a short distance of 50mm, finds the cavity of the socket and enters it. Being rigidly supported on the shoulders, the line is kept vertical for the next line of action, held in place by the arm. The third and final state constitutes the catching stage, where the socket pushes through the fingers. As the fisher descend, the socket advances to the palm, forces its way through and finally stops at the base of the cap. The fisher with the fish is then lifted out as a unit. Figures 20 to 24 are systematic scheme of the fishers operation. Figure 25 represents the overall plan view of the AZ-Fisher.

Table 2 is a break down of economic analysis of producing one AZ-FISHER. This gave an economic effectiveness of about 80%.

CONCLUSION

The design and construction of AZ-Hand Fisher has been completed but not without room for improvement as it is the case with any other innovation. It is hoped that it will be of use to the drilling industry. It costs N7030 a unit as shown in table 2. The materials are locally sourced.

The use of the fisher is limited to a situation where:

- The fish has a socket or collar as the case may be which is of a larger diameter than the next portion.
- The socket or collar is at the head of the line.
- The hole is cased and of uniform diameter except in a hard formation in which case the hole is of uniform diameter.
- The hole is bent-drilled.

In line with the above areas of limitations or deficiencies, the possible modifications are:

- In area where the socket or collar is not at the head of the line, the fisher can be modified. The modification involves the use of a body with a constriction at a point the length from the top is well above the length from the tip of the fish to the point the collar or socket is located. The constriction should be made in such a way that is makes a smooth curve such that a metal robbing against it will have minimal resistance gliding easily and finding its way into the constriction. The constriction performs the function of keeping the fish vertical while it enters into the trapping chamber. The palms should be placed just at the mouth of the constriction. In this modification the functions performed by the fist and the fingers may be taken over by the constricted end.
- In a situation where the cased hole is not of uniform diameter, the depth at which the fish head lies is determined and thus from the drilling information, the diameter of the fisher.

Table 1: Determination of spring constant using Hook's Law

Length, L_1 of spring in cm.	Length L_2 of spring in cm.	Extension e_1 of L_1 in cm.	Extension e_2 of L_2 in cm.	$e_1 - e_2$
57.90	58.55	0.00	0.00	0.000
58.05	58.60	0.15	0.05	0.100
58.20	58.65	0.30	0.10	0.200
58.40	58.80	0.50	0.25	0.375
58.50	58.90	0.60	0.35	0.475
58.60	58.95	0.70	0.40	0.550
58.70	59.05	0.80	0.50	0.650
58.85	59.10	0.95	0.55	0.750

Table 2: Production cost of the AZ – Fisher

Parts / Operation	Cost in Naira (N),
Welding	480
Purchase of hacksaw (2)	200
Purchase of grinding disc and grinder	300
Purchase of cylindrical body	3500
Drilling holes	300
Springs and housings	500
Cap, arm and shoulders	520
Bolts and nuts	120
Workmanship	1000
Plastic ball/steel ball	110
TOTAL	**7030**

REFERENCES:

1. Arlov.V. (1999). Limitations of fishing tools in drilling water boreholes, Sbornik Journals Moscow, YDK 622.145.7.20 - 35

2. Ershov. V.V. (1999), Geo-survey control of drilling operations, Mir publishers Moscow.

3. Anistratov V. (2000). Quality control of drilling equipment, Izvestia, Moscow, 85 (4): 50-66.

4. Anderson T. (2000). Problems of drilling in the mining industry. Sweden Publishers, Sweden.