DESIGN, MANUFACTURING, ANALYSIS OF MINING DIGGER BIT

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ABSTRACT:

A Down-The-Hole Drill is called DTH in most drilling terms. The down-the-hole drill is basically a mini jack hammer that screws on the bottom of a drill string. The fast hammer action breaks hard rock into small flakes and dust and is blown clear by the air exhaust from the DTH hammer. The DTH hammer is one of the fastest ways to drill hard rock. A pneumatic tool is first thought to have been used for rock drilling in 1844. Many quarries used hand held tools that required the driller to suspend himself from a rope over the quarry face in order to place the drill hole in the required position. This system used small diameter holes and was not only terribly inefficient' but very dangerous due to flying rock as a result of the inaccuracy of the drilled borehole. In DTH drilling, the percussion mechanism – commonly called the hammer – is located directly behind the drill bit. The drill pipes transmit the necessary feed force and rotation to hammer and bit plus compressed air or fluids for the hammer and flushing of cuttings. The drill pipes are added to the drill string successively behind the hammer as the hole gets deeper. The piston strikes the impact surface of the bit directly, while the hammer casing gives straight and stable guidance of the drill bit. This means that the impact energy does not have to pass through any joints at all. The impact energy therefore is not lost in joints allowing for much deeper percussion drilling. This is a great breakthrough for smaller portable water well drilling rigs, that before were limited. The DTH on smaller rigs now can get same results as large heavy truck rigs. In the present project bit preparation and its design analysis has been taken in to consideration and the whole properties have been observed.

INTRODUCTION

DTH is short for "down-the-hole". The down-the-hole drilling is used to produce large-diameter holes in rocks, usually in the initial stage prior to blasting, but it is also used in non-blasting applications. DTH drilling are used mostly in mining quarries but can be used in a variety of other construction applications. The DTH drilling method is growing in popularity, with increases in all application segments, including blast-hole, water well, foundation, oil & gas, cooling systems and drilling for heat exchange pumps. Applications were later found for the DTH method underground, where the direction of drilling is generally upwards instead of downwards.

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Different types of bits depending on the type of soil and the working conditions. The different types of bits are concave, convex and flat. The holes can be drilled ranging from 4 1/2 inch to 32 inch. The way to choose suitable drilling equipment

is complicated and a lot of information is required to reach performance and economy in the operation. Aspects that have to be taken into consideration are the purpose of the borehole, geology, hydrogeology pump, method of drilling, flushing media and so on.

The DTH button bit is the multi-point cutting tool that cut the rocks and soil used to make holes or bores in to the hard rock surfaces of the earth and to breaking the rocks and the solid masses of land in its way .it is the key part of entire rig. The down-the-hole bit is subject to severe stress from the striking piston as well as from the abrasive cuttings passing the bit at high velocity. When selecting the right bit for optimum performance to balance penetration against bit life. On occasion successfully sacrifice bit life for penetration. In such cases the rule of thumb that states that a 10% increase in penetration covers at least a 20% loss in bit life.

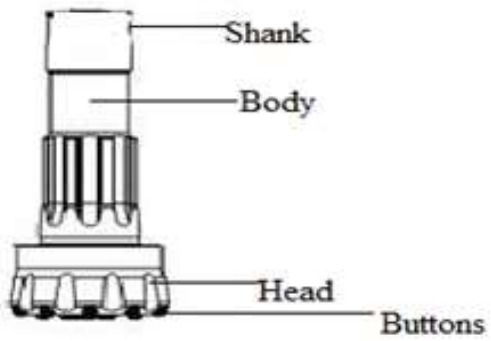

Fig: DTH button bit

Fig: Types of button bits

BUTTON BIT MANUFACTURING PROCESSES

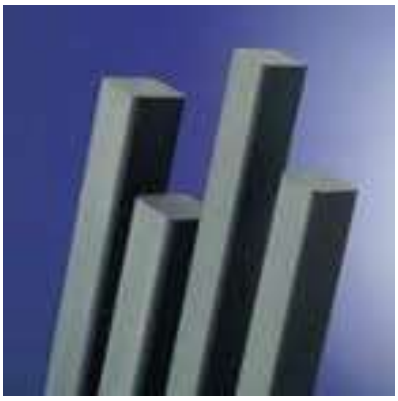

Fig: RCS bars

Round corner square bars are delivered in the as rolled stage. These bars have rounded edges; the radius is approximately, 15% of the side length. Round Corner Square Bars are available in standard size ranging from 20 mm to 160 mm. These are available in different grades such as carbon steel, and alloy steel and also in the specified grade as per the clients' requirements. These Bars are known for its features such as robust construction, durable, application specific design. These Bars are widely used in various industrial applications such as engineering, power generation, aerospace, ordnance, petrochemicals, infrastructure, real estate, railways, and forgings. Offered in standard options, these can be customized as per the requirements of the client.

Figure Material cutting.

Fig: Forging

Fig: work piece after annealing

Fig: Rough turning

Fig: Finishing machine

Fig: surface turning

Fig: Bore gauge

BUTTONS

Tungsten Carbide buttons has its unique performance and are widely applied to oil filed drilling and snow removal. According to the different oil-field drilling machinery such as roller cone bits, DTH bits, geotechnical drilling tools etc.

Carbide buttons are used in the coal cutter drilling tools, mine machinery tools and road maintenance tools for snow clearing and road cleaning. Carbide mining button bits are widely applied for rock tools, mining tools for use in quarrying and mining, tunneling, and civil constructions.

These are generally made of tungsten carbide, which is imported from West china .These are pressed into the holes of the bit. As this is a interference fit. The buttons once in cannot be removed out. 20 buttons are required for each button bit.

10 buttons needed for periphery and other 10 buttons needed for face.

SPECIFICATIONS OF BUTTON:

Model Basic dimensions

	D	H	R	a°	β°
Q1625	16.78	21.5	8.8	20	16

MATERIAL OF BUTTON:

Tungsten carbide (WC) is an inorganic chemical compound containing equal parts of tungsten and carbon atoms. Colloquially, tungsten carbide is often simply called carbide. In it is most basic form, it is a fine gray powder, but it can be pressed and formed into shapes for use in industrial machinery, tools, abrasives, as well as jewelry. Tungsten carbide is approximately three times stiffer than steel, with a Young's modulus of approximately 550 Gap, and is much denser than steel or titanium. It is comparable with corundum (α-Al2O3) or sapphire in hardness and can only be polished and finished with abrasives of superior hardness such as cubic boron nitride and diamond amongst others, in the form of powder, wheels, and compounds.

MODELING AND ANALYSIS OF BUTTON BIT

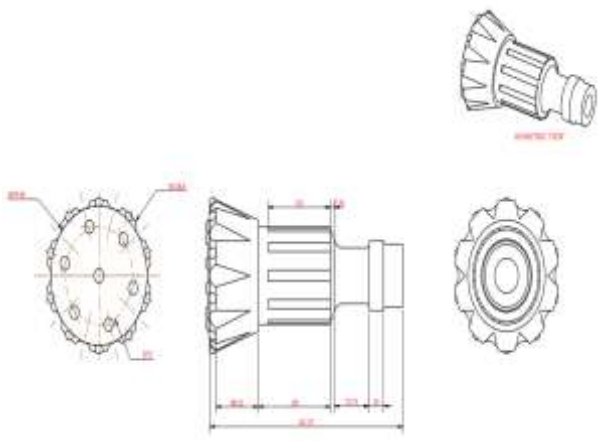

Fig: Modeling

TUNGSTEN CARBIDE-STRUCTURAL

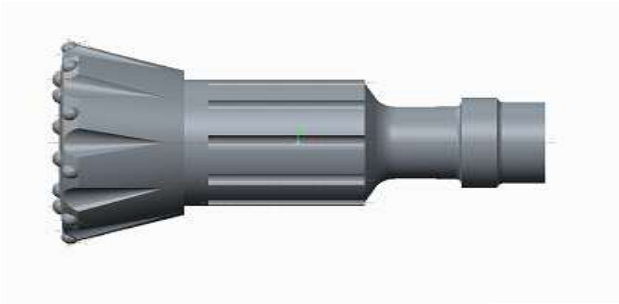

Fig: Front view of the CREO model

Fig: Left side view

Fig: front view of the CREO model

Fig: Top view of the CREO model

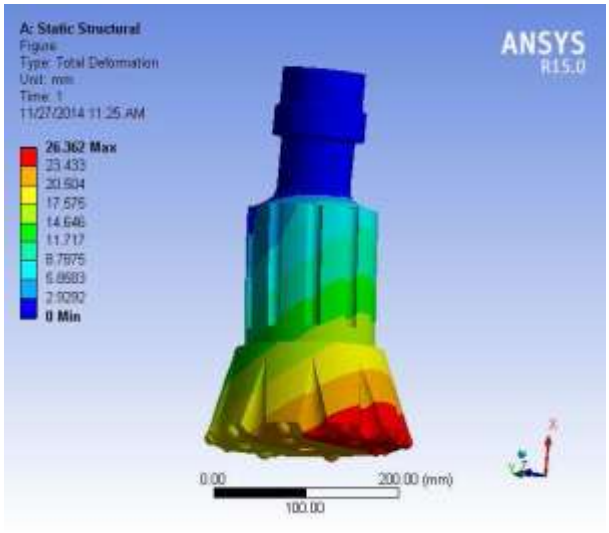

Figure: Static Structural Total Deformation

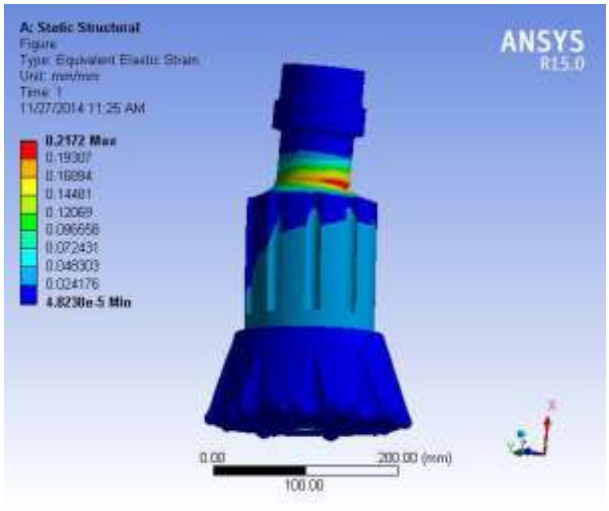

Figure: Static Structural Equivalent Elastic Strain

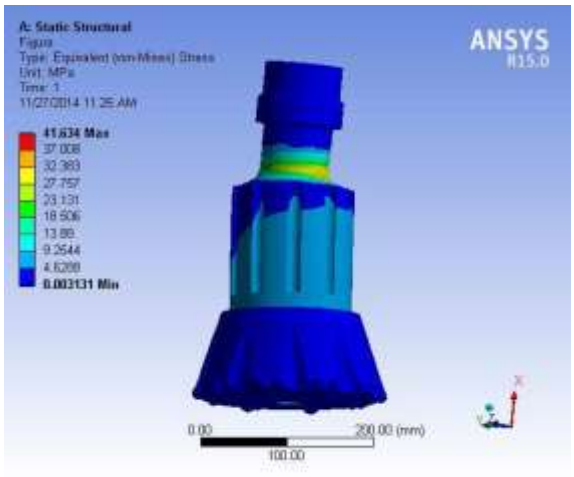

Figure: Model Static Structural Equivalent Stress

RESULTS BASED ON ANALYSIS

Material / values	Stress	Displacement	Strain	Allowable values
Tungsten carbide	1.886	0.521	0.0062	3440 Mpa
Titanium carbide	1.689	0.00054	0.0000054	2000 Mpa
Oil quenched Steel	1.718	0.00045	0.0000054	1345 Mpa

CONCLUSION

Based on the modeling and analysis software like CREO and ANSYS some of the results are obtained. These results are taken based on the stress , strain and deflection values of each material button bit .among all these materials oil quenched steel gives lower values of stress, strain ,deflection and thermal stresses than that of the remaining materials. By using of oil quenched steel buttons to the DTH button bit life is increased and it can sustain under high loads like 9 tones. So oil quenched steel buttons are preferable to overcome the problems that are faced by the DTH buttons bit like deflection, stress and strain.

FUTURE SCOPE

In KLR industries ltd they faces a problem that is during drilling of holes in to the hard rock surfaces of earth crust, wearing

of periphery of button bit takes place .This is due to rotation and linear moment of a button bit . for the reduction of this problem, they applied welding at the top of the round milling .the button bit already gets hardened during carburization .due to this application of welding it becomes brittle ,during rotation and a linear moment of a button bit in to the rock surfaces it leads to button cut and face cut.

For the remedy of that problem I suggested that instead of welding applying ceramic coating on the periphery of button bit .due to this ceramic coating the periphery of button bit gets hardened, and it improves the wear and tear resistance of button bit.

I hope that in future they may implement my suggestion to overcome the above problem i also suggested that by decreasing rough turning about 2mm there is a possibility for saving of materials about 2kgs .instead of rough turning if we can use exact dimensions of bit from the forging .It leads to availability of button bit at lower cost and also profits for the management.

In future There is a scope for reducing the weight of button bit and increase the strength by the using of different new trend materials like aluminum alloys and other type of materials .

Generally the life of the button bit is 2000 fts. In future there is a scope for increasing the life of button bit for 4000 fts.

Some of the DTH button bit failures are occur during operation they are Bottom Cut, Chip Off, Cracks, Shank Cut, Periphery Button Cut, Face Button Cut and V Shape Cut. In future these button bit failures requires remedies for the improvement of button bit life.

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3. Klr universal.com