

ENHANCEMENT OF ROCK DRILLING PERFORMANCE USING WATER SOLUBLE POLYMERIC ADDITIVES



Thesis submitted in partial fulfilment for the
Award of Degree

Doctor of Philosophy

by

ROHIT RAWAL

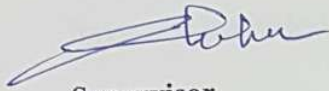
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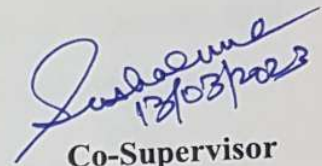
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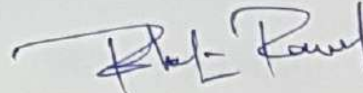
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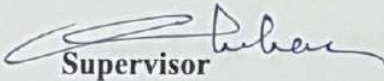
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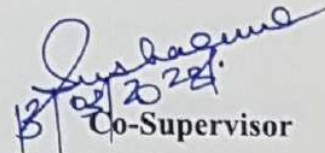
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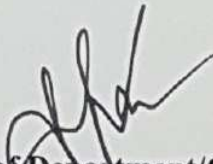


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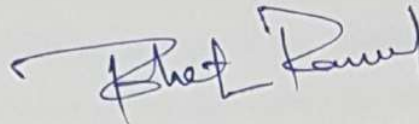
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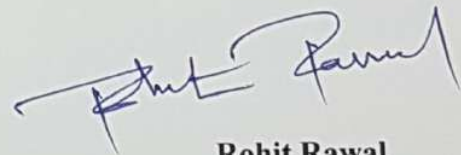
First and foremost, from the core of my heart I would like to pay homage and tributes, to the great soul of **Mahamana Pandit Madan Mohan Malviya ji**, the revered founder of this beautiful temple of learning. His divine figure has always remained a source of courage, inspiration and motivation, a guiding light and a supreme example of patriotism and willpower in the form of Banaras Hindu University.

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LIST OF ACRONYM

O.D.	Outer Diameter
I.D.	Inner Diameter
EC	Energy Consumption
CEC	Constant Energy Consumption
RPM	Rotation per Minute
ROP	Rate of Penetration
SEC	Specific Energy Consumption
RRR	Rock Removal Rate
RMS	Root Mean Square
VTV	Vibration Total Value
CMC	Carboxymethyl Cellulose
GG	Guar Gum
PAM	Poly Acrylamide
PAMPS	Poly-2-Acrylamido-2-methyl propane sulfonic acid
St	Starch
AP	Amylopactin

ABSTRACT

Rock drilling is an important operation for all industries related to rock cutting and fragmentation, namely mining, petroleum, natural gas, civil engineering, etc. In the mining industry, the drilling operation alone has a significant impact on the time and cost involved in the mineral excavation. By improving the efficiency of the drilling process, the overall profit of industries can be significantly enhanced. Several machine parameters play crucial roles in controlling the efficiency of rotary drilling process, such as bit parameters, thrust on the bit, bit rotational speed, type of flushing media, etc. The flushing media plays a vital role in drilling operation namely, cleaning drill cuttings from the bit-rock interface, and providing fresh cutting surfaces to the bit. In the absence of flushing media, the accumulated cuttings at the hole bottom would go under regrinding causing wastage of drilling energy. The flushing media or drilling fluid can be utilized to solve plenty of drilling problems.

In experimentation, impregnated diamond core bit (19/12 mm) has been used to drill chunar sandstone samples, on fabricated setup, along with wide variations in input parameters (bit rotation speed and load on bit) . As drilling fluid, various ppm concentrations in an aqueous solution of water-based additives namely, polymers [i.e. carboxymethylcellulose (CMC), guar gum (GG), polyacrylamide (PAM), and PAMPS], grafted polymers [i.e. St-g-PAM, AP-g-PAM, and St-g-PAMPS], and hydrolyzed polymers [i.e. Hy-St-g-PAM, and Hy-AP-g-PAM], and tap water alone were experimented to identify their impact on performance parameters namely rate of penetration (ROP), energy consumption, specific energy consumption (SEC), rock removal rate (RRR), machine vibration, bit temperature, bit wearing etc.).

It can be concluded with this study the laboratory testing setup for studying drilling performance is convenient as well as economical in comparison to field testing and the role of RPM feedback system was vital in it. The optimum flushing rate for laboratory setup was identified as 31.5 L/hr,

which helped in reducing the wastage of fluid and improving ROP. Also, It was adduced with the intra-hole drilling study, that in the absence of flushing media, a significant drop in ROP was noticed. Furthermore, as an effect of the depth of the hole, a drop in ROP has been observed. Also, to improve rate of penetration and overall performance CMC 70 ppm, and Hy-St-g-PAM 90 ppm has shown significant improvements, respectively. And as an eco-friendly natural polymeric additive (GG) has also performed appreciable.