

**Sudan University of Science
and Technology
College of Graduate Studies**



**IMPROVEMENT OF PHYSICAL PROPERTIES FOR
DRILLING FLUIDS USING GUM ARABIC, SORGHUM
AND GUM ARABIC / SORGHUM MIXTURE**

تحسين الخواص الفيزيائية لسائل الحفر باستخدام الصمغ العربي ، سيقان الذرة
وخليط الصمغ العربي – سيقان الذرة

**A Thesis Submitted in Partial Fulfillment for the Requirements of
PhD in Petroleum Engineering**

By:

Shams Alflah Ahmed Ali Balola

Supervisor: Dr. ABDALLA HASSAN WAGI ALLA

Co - Supervisor: Dr. AHMED ABD ELAZIZ IBRAHIM

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الاستهلال

قال تعالى :

وَالْأَرْضَ مَدَدْنَا هَا وَأَلْقَيْنَا فِيهَا رَوَاسِيَ وَأَنْبَتْنَا
فِيهَا مِنْ كُلِّ شَيْءٍ مَوْزُونٍ (19) وَجَعَلْنَا لَكُمْ
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وَإِنْ مِنْ شَيْءٍ إِلَّا عِنْدَنَا خَزَائِنُهُ وَمَا نُنزِّلُهُ إِلَّا
بِقَدَرٍ مَعْلُومٍ (21) صدق الله العظيم

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من حديث أبي سعيد الخدري عن النبي(ص) قال : (إن أخوف ما أخاف عليكم
ما يخرج الله لكم من بركات الأرض، قيل: ما بركات الأرض؟ قال: زهرة
الدنيا، قال رجل: هل يأتي الخير بالشر؟ فصمت رسول الله حتى ظننت أنه
ينزل عليه، ثم جعل يمسح عن جبينه قال: أين السائل؟ قال: أنا، قال: لا يأتي
الخير إلا بالخير)

DEDICATION

I AM PLEASED TO DEDICATE THIS STUDY TO :

:

MY MOTHER AND MY FATHER

MY WIFE

MY BROTHERS

DEAR FRINEDS

&

TO EACH ONE WHO HAD TAUGHT ME A SINGLE LETTER

WITH MY BEST REGARDS ُ

S. FALAH

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Abbreviations

°C	Degree of centigrade
MPa	Mega Pascal
lb / gal	bound / gallon
WBDs	Water Base Drilling Fluid
Na+	Soda ash
Ca++	Calcium
K+	Potassium
OBM's	Oil based mud's
ROP	Rate of penetration
E.C.S.W	Equivalent circulating specific weight
CPS	Centipoises
AV	Apparent Viscosity
(PV	Plastic Viscosity
ft/sec	Feet / second
m	Meter
Cm / Cs	Centimeter
Lbs/100ft ²	bound / 100 feet ²
V	Viscometer
G Meter	Gravity of meter
Yp	Yield point
PH	Hydrologic acid
°F	Degree Frenhight
API	American Petroleum Institute
n	indicates the degree of non-Newtonian
K	viscous the consistency factor

Rpm	Rotation per ment
Na OH	Caustic
MW	Molecular Weight
MN	Molecular Number
g/cm^3 ,	gram / centimeter ³
Pac LV	Pac Low Viscosity
θ_{300} , θ_{600} , θ_{100}	Six speed Viscometer
θ_{200} , θ_{10mjn} , θ_{610mjn}	
HP-HT	High pressure – High Temperature
μ_a	the apparent viscosity
μ_p	the plastic viscosity
YP	the yield point
Gels	gel strength
YP/ μ_p	Yield point / Plastic viscosity
D_1	Inside diameter of drill pipe
D_2	Outside diameter of drill pipe
D_s	drilling cutting diameter.
NRp	particle Reynolds number.
Vsl (ft/sec)	particle slips velocity.
f_s (ppg)	cutting density.
Tg (lbf/100ft ²)	gel strength required to suspend a particle of diameter.
V-	Fluid Velocity
TFA	total flow area (in ²)
dn	nozzle size in multiples of 1/32in
3D	3 daimansion
T	Taleh Gum Arabic
D	Damazeen Gum Arabic

J	Abu Jibaiha Gum Arabic
V	Slip Velocity
V	Flow velocity
ECD	equivalent circulating density
P bit, Pc	Hydraulic horse power at the bit
d n	Nozzle Selection
IF	The impact force
p	flow rate

ABSTRACT

The process of drilling of Petroleum wells depends largely on the properties of the drilling fluid. Such properties could be improved by the addition imported materials.

The intent of this research is to improve the drilling fluid properties using local materials and additives in the formulation of the new drilling fluid and thus reduce the cost of the drilling process. This in turn has a positive effect on the national economy.

This research utilizes three types of local additives; Gum additive, Sorghum additive and Gum – Sorghum additive Different percentages of each additive was prepared as a water –based drilling fluid sample and then tested using standard laboratory devices and standard laboratory procedures under specified conditions. The sample was subjected to different temperatures, but under a constant pressure, speed and density. The results were analyzed and the optimum percentages were determined.

The Gum additive drilling fluid sample consists of three kinds of Gum: Taleh, Abu Jibaiha, Damazeen and each was tested separately and analyzed. The results showed that percentage 0.76% was the low optimum percentage for all the three kinds of Gum and the high optimum percentage was 21.44% for Taleh and Abu Jibaiha, while Damazeen had a high optimum percentage of 9.4%.

The Sorghum additive sample had a low optimum percentage of 0.57% and a high optimum percentage of 2.78%.

The Gum – Sorghum additive proved to be optimum for Damazeen –Sorghum and had an optimum percentage of 6.9%.

This research concluded after methodical application of the test results by comparison with data from Bamboo wells procedure, which showed an improvement in the drilling fluid properties when using these additives,

The optimum samples will be available commercially as: ‘Falah Gum / Sorghum / Gum-Sorghum Fluids.

الخلاصة:

عملية حفر آبار البترول تعتمد إلى حد كبير على خصائص سائل الحفر. ويمكن تحسين هذه الخصائص بإضافة مواد مستوردة. الهدف من هذا البحث هو تحسين خصائص سائل الحفر باستخدام المواد المحلية كمادة مضافة في صياغة سائل الحفر الجديد وبالتالي خفض تكلفة عملية الحفر. وهذا بدوره له تأثير إيجابي على الاقتصاد الوطني. تم إعداد نسب مختلفة من كل المواد المضافة، مادة الصمغ، مادة سيقان الذرة ومادة الصمغ - سيقان الذرة في سائل حفر ذو أساس مائي، ومن ثم اختبارها باستخدام الأجهزة المختبرية القياسية والإجراءات المختبرية القياسية في ظل ظروف محددة، من درجات حرارة مختلفة، ضغط، سرعة حفر وكثافة سائل ثابتة. وقد تم تحليل النتائج وتم تحديد النسب المثلى.

ماده الصمغ تتكون من ثلاثة أنواع من الصمغ هي: طلع، أبو جبيهه ودمازين، وكان اختبارها وتحليلها كل على حدة. وأظهرت النتائج أن نسبة 0.76% هي النسبة المنخفضة المثلى لجميع الأنواع الثلاثة من الصمغ ونسبة 21.44% هي النسبة العليا المثلى لصمغ للطلع وأبو جبيهه، في حين كانت نسبة 9.4% هي النسبة العليا المثلى لصمغ الدمازين.

وكانت نسبة عينة الذرة المضافة المنخفضة المثلى هي 0.57% والنسبة المثلى العليا هي 2.78%، وكانت النسبة المضافة من عينة الصمغ - الذرة المثلى هي . والتي ثبت أن العينة الامثل هي الدمازين - ذرة 6.9%.

وخلص هذا البحث بعد تطبيق منهجي لنتائج الاختبار عن طريق إجراء المقارنة مع البيانات من آبار بامبو، والتي أظهرت تحسنا في خصائص سائل الحفر عند استخدام هذه الاضافات،

العينات المثلى ستكون متاحة تجاريا باسم : سوائل صمغ / ذرة / صمغ- ذرة فلاح