King Saud University
College of Engineering
Petroleum and Natural Gas Engineering Department

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TESTING THE POTENTIAL SUITABLITY OF A SAUDI YAMAMA PORTLAND TYPE 1 CEMENT FOR OIL AND GAS WELL CEMENTING JOBS

(Group Work)

PART TWO: Investigation of Factors Affecting Cement-Casing and Cement-Formation Shear Bonds Strength

By

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Abstract:

Oil well cementing is an integral and a necessary aspect operation in the drilling and completion of oil and gas wells. Cement is used to protect casing strings and as zonal isolations for production purposes as well as to solve various holes problems. In order to perform the cementing process, cement slurry must be carefully designed to fulfill the requirement of the reservoir condition. The aim of this study was to investigate the suitability of Yamama Portland cement type 1 for use in oil and gas well cementing jobs. This was done by studying the effect of mixing water type, curing environment, and type of additives on cement mechanical properties. Bonding strength between cement and casing as well as cement bonding between cement and formation were thoroughly investigated. Effect of casing surface contamination and casing centricity were also studies. It was found that a slurry composed from Yamama cement type 1 + 25% local sand + 40% fresh water developed a uniaxial compressive strength of 30.40 MPa which far beyond that required by standards (3.45 MPa). This composition was used for all tests performed for the investigation of cement-casing and cement-formation bond strength. Cement-casing bond strength (1.4 MPa) and cement-formation bond strength (11.48 MPa) are satisfying the required standard value (3.45/12=0.29 MPa). Casing centricity and casing size have a small effect on cement-casing bond strength. However, casing surface contamination by oil has reduced the cement-casing bond strength by 43%. Bentonite contamination has a negligible effect on cement-casing bond strength. Based on all measured properties, Yamama cement type 1 is suitable for use in oil and gas well cementing operations. However, for a sloid conclusion, tests performed in this study should be repeated under high temperature-high pressure conditions.

Objectives:

Investigation of Factors Affecting Cement-Casing and Cement-Formation Shear Bonds Strength):

- Testing cement-casing and cement-formation bond strength.
- Testing the effect of casing contamination on cement-casing bond strength.
- Testing of the effect of casing centricity on cement-casing bond strength.
- Testing of cement thickness around casing on cement-casing bond strength.
- Determining the relationship between cement compressive and tensile strength and cement-casing and cement-formation bond strength.

Tested Raw Materials:

Fig. 1 Yamama Portland cement (Type 1)

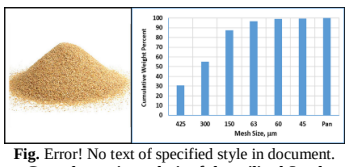


Fig. Error! No text of specified style in document. **Granulometric analysis of the utilized Sand**

Performed Lab. Tests:

Fig. Error! No text of specified style in document. **Cement-Casing Bond Strength Testing**

Fig. Error! No text of specified style in document. **Cement-Formation Bond Strength Testing (Conventional Test)**

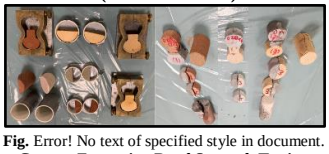
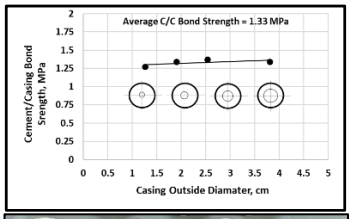


Fig. Error! No text of specified style in document. **Cement-Formation Bond Strength Testing (Unconventional Tests)**

Results:



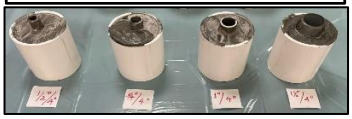


Fig.6 Casing Size Versus C/C Bond Strength

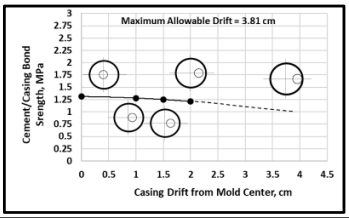


Fig 7. Casing Size Versus C/C Bond Strength

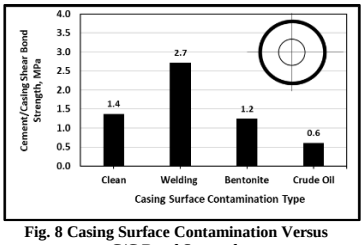


Fig. 8 Casing Surface Contamination Versus C/C Bond Strength

Fig. 9 Conventional C/C Bond Strength Testing

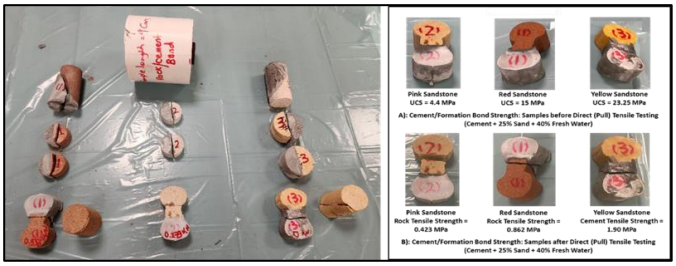


Fig. 10 Unconventional Cement-Casing Bond Strength Testing

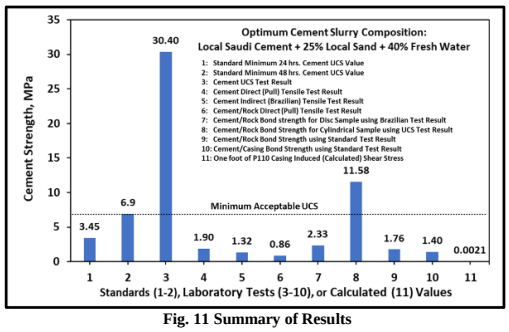


Fig. 11 Summary of Results

Conclusions and Recommendations:

- Based on all measured properties, Yamama Portland cement type 1 is suitable for use in oil and gas well cementing operations.
- It is recommended to perform further studies under high temperature – high pressure conditions.