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 ONE: Investigation of Factors Affecting Hard-Set Cement Compressive and Tensile 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 and bonding strength.

It was found that 25% local Saudi sand addition is technically accepted since it is developed acceptable cement strength and thickening properties. 40% fresh water as mixing water provided maximum uniaxial compressive strength. The ratio of uniaxial compressive strength to direct (pull) tensile strength is located in the range between 14 and 19. There is a direct relationship between direct (pull) tensile strength and indirect (Brazilian) tensile test results. Using fresh water or sea water as mixing water provided clos results for the uniaxial compressive strength. Also, it was found that a slurry composed from Yamama cement type 1 + 25% local sand + 40% fresh water developed 87% of the final uniaxial compressive strength after 7 days and 99% of the final uniaxial compressive strength value after 14 days.

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 Hard-Set Cement Compressive and Tensile Strength):

- Determining the optimum mixing water for cement.
- Studying the effect of curing water on cement strength.
- Studying the effect of sand addition on cement strength.
- Studying the effect of curing time on cement strength.
- Studying the effect of contamination on cement strength.

Determining the relationship between cement compressive and tensile strength.

Tested Raw Materials:

Fig. 1 Yamama Portland cement (Type 1)

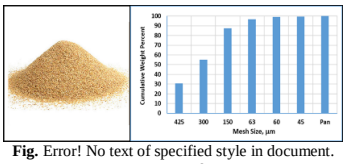

Fig. Error! No text of specified style in document. **Granulometric analysis of the utilized Sand**

Performed Laboratory Tests:

Fig. Error! No text of specified style in document. **Uniaxial Compressive Strength Testing**

Fig. Error! No text of specified style in document. **Direct (Pull) Tensile Strength Testing**

Fig. Error! No text of specified style in document. **Indirect (Brazilian) Tensile Testing**

Results:

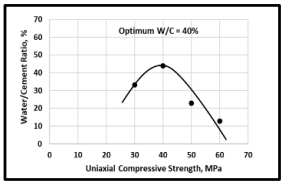

Fig.6 Optimum Water/Cement Ratio

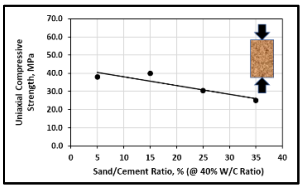

Fig 7. Optimum Cement/Sand Ratio

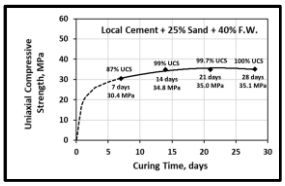

Fig. 8 UCS Versus Curing Time

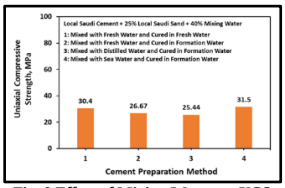

Fig. 9 Effect of Mixing Water on UCS

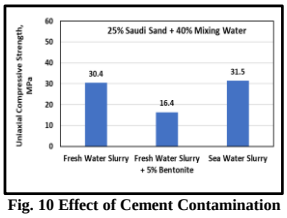

Fig. 10 Effect of Cement Contamination on UCS

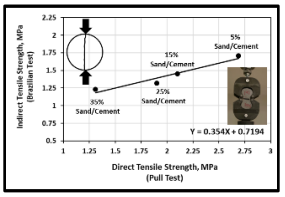

Fig. 11 Relationship between Direct (Pull) and Indirect (Brazilian) Tensile Strength

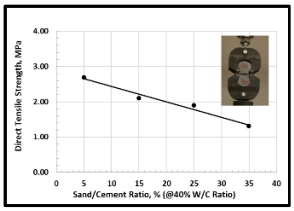

Fig. 12 Sand Content Versus Tensile Strength

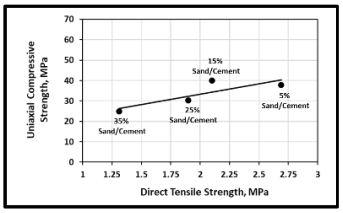

Fig. 13 Relationship between Tensile Strength and UCS

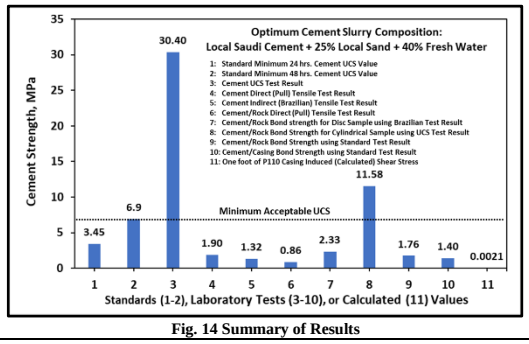

Fig. 14 Summary of Results

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.