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Design and analysis of centralizer used in wellbore

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Abstract

A centralizer is an equipment used to keep sheath center of wellbore to ensure good placement of cement sheath around casing string. A continues 360 annular space around casing leads cement to complete seal the casing to borehole wall. The bows of welded type centralizer are bend with the dies and bows are not directly in contact with whole pipe so no contact between bows and hole pipe results the less friction between centralizer and hole pipe. In the Welded semi rigid type centralizers introducing bending of bows improve bow strength to hold the weight of outer pipe or hole pipe results high resistance power. The study of Different Models in order to Test the Centralizer, Stop Collar and Float Equipment. The Purpose of Testing of Centralizer to Examine the Starting, Running and Restoring Force of Centralizer and Float Equipment for Ductility and high Pressure and High Temperature Test as they uses in oil Field Industry. The Resulting Data from these Tests are meant to check the Quality as well as basis for Improving the Design of Centralizer, Stop Collar and Float Equipment.

Keywords: wellbore, design, centralizer

1. Introduction

Centralizer is an equipment used to keep sheath center of wellbore to ensure good placement of cement sheath around casing string. A continues 360 annular space around casing leads cement to complete seal the casing to borehole wall. A Casing centralizer is equipment safe from one place to another the casing at different positions to retain the casing from touching the wellbore walls. Its end result of covering centralization, a constant annular clearance everywhere the casing permit cement to entirely close the casing to the borehole wall. Casing centralization device guarantee the value of a cementing job by escaping mud channeling and poor zonal isolation. It is expectable that 10 million centralizers are mass-produced and used every year worldwide. Centralizer producers likely want to raise the demand for centralizers. Casing centralizer is used to ensure keep casing from contacting the wellbore wall. Tool centralization can be required for following reasons.

a) To prevent tool from hanging up on obstructions or blockage on wellbore wall.
b) To pass fluid efficiently and prevent excessive standoff.

There are four different types of centralizers.

a) Bow spring design
b) Semi rigid design
c) Rigid blade design
d) Mold on design

Stand-off means the extent to which pipe is centered or separation of casing from wall of hole is called stand-off. The 100% stand-off means the casing is perfectly centered. The 0% stand-off means stand-off means the pipe is in contact with wellbore. According to API the stand-off should be above 67% throughout the casing string. Stand-off = C/ (A-B). To study the casing deflection we must study the force balance for pipe segment. There are two types of forces on casing:

a) Gravitational force on pipe body, pulling casing downwards.
b) Axial tension force at end, pushing casing upward.

Depends on weight and tension of casing the net side force is either upward or downward.

To do the Calculations of models there are three methods used to set the placement of centralizer at efficient place.

a) Specify spacing-The standard spacing between two centralizer is 40 feet (1 centralizer per joint). The standoff at the middle point is always lower than at centralizer because of bow spring centralizer used here the standoff at middle point between centralizers is sum off casing sagging between the centralizer and at bow spring compression at centralizers.
b) Specify standoff-The separation of casing from wall of hole is called stand-off. On the mid-span between centralizer the stand-off will be setup. The Specify standoff mode ensures minimum standoff will be setup. The “specify standoff” mode ensures minimum standoff of casing between centralizer. According to API the minimum 67% standoff will be required as per requirement.
c) Optimum spacing-To get the optimum placement of centralizer on pipe the both approaches have specifying standoff 70% with incremental space requirement 20ft.

2. Research Methodology

2.1 Introduction of 5S

5S is the name of place of work involvement method that uses an inventory of five Japanese words: *seiri*, *seiton*, *seiso*, *seiketsu*, and *shitsuke*. 5S engage community through the exercise of 'Standards' and 'Discipline'. It is not just about maintenance, but focused to maintain the values & guideline to administer the group - all achieved by continuation & viewing respect for the office every day.

The 5 Steps are as follows:

a) **Sort**: reform & split the one which is desirable & not needed in the area.
b) **Straighten**: place items that are desirable so that they are complete & simple to use. Undoubtedly recognize locations for all items so that anybody can locate them & return them once the job is finished.
c) **Shine**: Clean the place of work & tools on a usual base in order to preserve values & spot the defects.
d) **Standardize**: re-examine the first three of the 5S on a common root and verify the state of the workplace using normal actions.
e) **Sustain**: maintain to the rules to preserve the standards & go on to improve every day.

Introduction of Seven QC Tools

The Seven Basic Tools of Quality is a description given to a predetermined set of graphical technique recognized as being most supportive in resolving issues allied to quality. They are called *basic* because they are appropriate for community with minor proper training in figures and because they can be used to resolve the vast mass of quality-related issues.

1. Cause-and-effect diagram (also known as the "fishbone" or Ishikawa diagram)
2. Check sheet
3. Control chart
4. Histogram
5. Pareto chart
6. Scatter diagram
7. Stratification (alternately, flow chart or run chart)

The Seven necessary Tools rest in distinction to other highly developed numerical methods such as survey sampling, acceptance sampling, statistical hypothesis testing, design of experiments, multivariate analysis, and various methods developed in the field of operations research.

Introduction of Kaizen

Kaizen is the practice of continuous improvement. Kaizen was originally introduced to the West by Masaaki Imai in his book Kaizen: The Key to Japan's Competitive Success in 1986. Today Kaizen is recognized worldwide as an important pillar of an organization's long-term competitive strategy. Kaizen is Continuous Improvement that is based on certain guiding principles:

1. Good processes bring good results
2. Go see for yourself to grasp the current situation
3. Speak with data, manage by facts
4. Take action to contain and correct root causes of problems
5. Work as a team
6. Kaizen is everybody's business
7. And Much more

3. Proposed Work

Welded bow type centralizer are made up of cast iron and available in various size and made by different types of materials. These centralizers have high resistance power and long lasting. In the welded type centralizer bows are made under high temperature conditions with correct grade electrodes. In this type bows are not directly in contact with hole pipe so no contact between bows and hole pipe. So this results the less friction between centralizer and hole pipe. The bows are of high quality alloy steel and change into required shape by use of dies and then heat treatment will be done under temp/time cycles for required spring characteristics. These centralizers are used where stress points are few.

Table 1: Parameters of Welded Type Centralizer

Size	$5^{1/2"}$ X $18^{1/2"}$
Weight	4.416 Kg
Height	35.5 cm
Thickness	mm

Fig 1: Welded type Centralizer

Welded semi rigid bow spring centralizer

The semi rigid bow spring centralizer are good robust design, reliable and are of high performance. These are made up of cast iron and available in various size. The highly treated bows are welded on end collar of centralizer. The bows are first bent as per requirement with the help of dies then we do heat treatment of bows at temp/time cycle under requirements. The small area that bent are in contact with hole pipe which increases friction between centralizer and hole pipe. These type of centralizers are used where stress points are large or where stress is too high.

Fig 2: Welded semi rigid type centralizer

Table 2: Parameters of Welded semi rigid type centralizer

Size	$5^{1/2"}$ X $17^{1/2"}$
Weight	3.526 Kg
Height	35.5 cm
Thickness	mm

4. Results and Analysis

Starting Force Test

The starting force indicates the detailed force required to put the inner pipe into the outer pipe (after make up for the weightiness of the inner pipe and additions).

a) First step to test starting force of centralizer mount the centralizer in fully assembled condition. We must ensure that centralizer assembled in same manner as used in actual service.
b) The test should be performed at an angle of 5 degree of vertical position.
c) The contacting area of centralizer to the outer pipe must lubricate with petroleum based grease so that centralizer must move easily.
d) Apply the load by universal testing machine (UTM) on the inner pipe to insert centralizer into outer pipe.
e) Then take the readings at various load/time conditions. Check the maximum force that is required to fully insert the centralizer inside the outer pipe.
f) Check whether the centralizer was pulled or pushed into the outer pipe
g) Check the holding device used to conduct the starting force test.

Running Force

The running force signifies the extreme force needed to move the inner pipe inside the outer pipe when the force reading has become fixed (after reimbursing for the heaviness of the inner pipe and additions

a) Install First step to test starting force of centralizer mount the centralizer in fully assembled condition. We must ensure that centralizer assembled in same manner as used in actual service.
b) The final outcome of this test is not compulsory to note the maximum value. This test should be performed and final outcome will be recorded.
c) This test can be done when the starting force test going on or do this test separately.
d) Take different readings of force at different period of time when centralizer is moving inside the outer pipe until the inner pipe is fully placed.
e) Write down the maximum force as the running force after reparation as in 1.

Restoring Force

The restoring test can be used to test the bows strength that how much force absorbed by the bows of centralizer.

a) The restoring test can be done by setting up the pipe at an angle of 5 degree horizontal.
b) The force applied to the bows upto 12 times to check strength ability of bows.
c) Put the load by universal testing machine to the outer pipe so that load will be transported to the inner pipe vertically over the point of contact of the centralizer with the outer pipe
d) Put on load and read load-deflection analyses at least possible of 1, 6 mm (1/16 in) rises until three times (±5 %) the smallest restoring force has been attained. The travel distance to obtain 67 % standoff shall be discover out for each test position.
e) Repeat the process, testing the centralizer until each spring and each set of springs has been tested in situations 1 and 2 as shown in Figure.
f) Determine the total load at each deflection by recompensing for the mass of the move pipe and attachments.
g) Make the final load-deflection curve using the calculation average of the force readings at corresponding deflections. Restoring force shall be find out from this curve at 67 % standoff ratio.

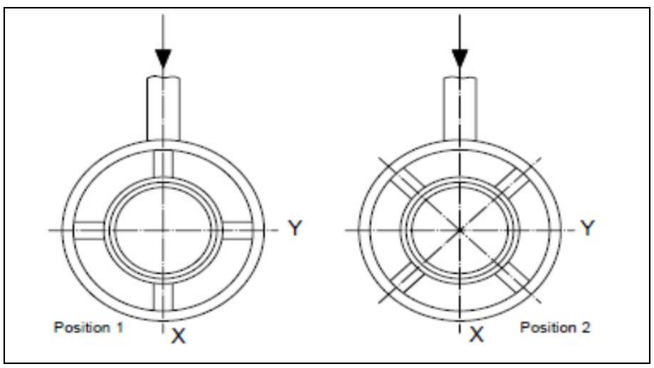
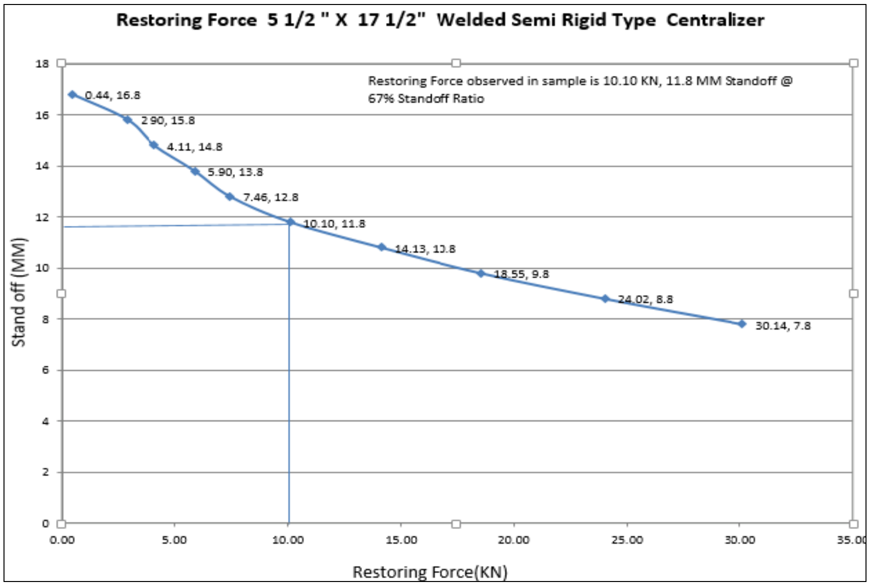
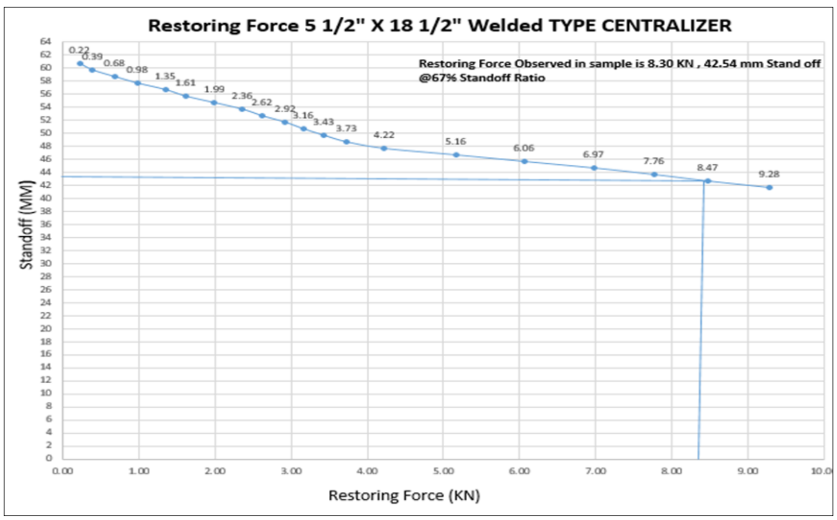


Fig 3: Example of Casing Centralizer for Restoring Force Equipment



Graph 4.1: Welded Semi Rigid Type Centralizer



Graph 4.2: Welded Type Centralizer

Compression Test of Sledge Chakra

Compressive strength is the ability of a material or assembly to endure loads inclining to decline size, as opposite to tensile strength, which persists loads tending to extend. In other words, compressive strength repels compression (being pushed together), whereas tensile strength struggles tension (being pulled apart). In the study of strength of materials, tensile strength, compressive strength, and shear strength can be analyzed independently. Compressive strength can be measured by plot graph between applied forces compared to deformation on a universal testing machine.

Fig 4: During Compression Test

Fig 5: After Testing Compressed Piece

Table 3: Results of Compression Strength

TEST	RESULT
Load At Peak	136.860KN
Elongation at Peak	7.050MM
Compression Strength	12.942N/MM^2

5. Conclusion and Future Scope

A Welded semi rigid bow spring centralizer for wellbore applications is proposed. This type of centralizer is flexible and can operate in various wellbore applications. Introducing bending of bows improve bow strength to hold the weight of outer pipe or hole pipe. A Welded semi rigid bow spring centralizer provides larger Starting force, running force. This type of centralizer also having more absorption energy than welded type centralizer. The nut bolt attached to both sides of centralizer which removes the usage of stop collar. The main highlights of this thesis are the welded semi rigid bow spring centralizer of proposed structure with given dimensions promise the large restoring force and larger starting and running force than welded type centralizer. Future scope of these centralizers are functions as centralization and mud removal. It is one of the most important factors in obtaining a good cement job. Effective centralization assists in mud removal and helps ensure an even cement coat around the casing. Certain running procedures, such as pipe reciprocation and rotation, improve the mud displacement process. Centralizers for horizontal wells have to fulfill two requirements: They should have a high restoring capability and a low moving force, and they should allow pipe rotation and reciprocation. Conventional bow-type centralizers have been used effectively in some horizontal wells. But as the horizontal section length increases, special centralizers, such as low-moving-force, bow-type centralizers and rigid centralizers, may be essential. The welded semi rigid type centralizer with stop collar is designed for future wellbore applications with API Specifications

6. Reference

1. Lee HK, Smith RC, Tighe RE. Optimal Spacing for Casing Centralizers, SPE Drilling Engineering, P. 122 – 130, April. C.A. Johancsik, *et al*, Torque and Drag in Directional Wells – Prediction and Measurement, SPE, 1986.
2. Reprint Series, No. 30, Directional Drilling, 1990, P. 130. API Specification 10D for Bow-Spring Casing Centralizers, 1990.
3. Wu Jiang, Chen P, Juvkam-Word HC. “Casing Centralization in Horizontal Wells”, Popular Horizontal, P. 14 – 21, April/June, 1991.
4. Juvkam-Word HC, Wu Jiang. “Casing Deflection and Centralizer Spacing Calculations,” SPE Drilling Engineering, P. 268-274, December, 1992.
5. API. Bulletin 5C3 on formulas and calculation for casing, tubing, drill pipe properties. American Petroleum Institute, Exploration and Production Dept, 1994.
6. Wisniowski R, Gonet A, Capik M. Numerical Aided Decision Making Regarding Centralizers’ Placement on Casing String. International Conference on Applied Mathematical Methods in Science and Technology, Cracow, June 20-21, 1995.
7. Gonet A. A Method of Placing Centralizers on Casings. IX. International Conference, Kosice, September 2-4, 1997.
8. Liu PL, Lee KH, Wu TT, Kuo MK. Scan of surface-opening cracks in reinforced, 2001.
9. Concrete using transient elastic waves. NDT&E Int 34:219-26.
10. Hossein-Pourazad H. High temperature geothermal well design. Report 9 in: Geothermal training in Iceland 2005. UNU-GTP, Iceland, 111-123, 2005.
11. Erik B. Nelson and Dominique Guillot, Well Cementing, 2nd Edition, published by Schlumberger, 2006.
12. Tikhonov VS, Safronov AI, Gelfgat MYa. Method of Dynamic Analysis of Rodin-Hole, 2005.
13. Buckling. Proceedings, 8th Biennial ASME Conference on Engineering Systemsand Analysis, Torino, Italy (2006), Paper ESDA2006-95059, 2006.
14. Aichouni, M. „Quality Control - The Basic Tools and their Applications in Manufacturing and Services‟, ISBN 6690-75-688-2,Dar Al-Asshab Book Publishing, Riyadh, 2007.
15. Walker HF, Levesque J. 'The Innovation Process and Quality Tools', Quality Progress, Vol. 40, No. 7, July, pp. 18/22, 2007.
16. Hole H. Geothermal well design - casing and wellhead. Petroleum Engineering Summer School, Workshop 26, Dubrovnik, Croatia, June, 2008.
17. Elders A, Fridleifsson GÓ. The science program of the Iceland Deep Drilling Project (IDDP): Study of supercritical geothermal resources. Proceedings of the World Geothermal Congress 2010, Bali Indonesia, 9, 2010.
18. Atlas Copco. The predator drilling system. Atlas Copco Oil and Gas Rigs, 2010. website: www.atlascopco.com/images/ac_predator_brochure_lores_tcm45-3526711.pdf.
19. Thórhallsson S, Pálsson B, Hólmgeirsson S, Ingason K, Matthíasson M, Bóason HA *et al*. Well design and drilling plans of the Iceland deep drilling project (IDDP). Proceedings of the World Geothermal Congress 2011, Bali, Indonesia, 8 pp, 2010.

20. Thórhallsson S. Geothermal well operation and maintenance. In: Fridleifsson, I.B., and Gunnarsson, M.V. (eds.), Lectures on the sustainable use and operating policy for geothermal resources. Short course prior to the International Geothermal Conference, IGC 2003. UNU-GTP, Iceland, 195-217, 2012.
21. 22. Chai HK, Aggelis DG, Momoki S, Kobayashi Y, Shiotani T. Single-side accesstomography for evaluating interior defect of concrete, Construction and Building Materials 24 2411–2418, 2012.
22. Aggelis DG, Hadjiyiangou S, Chai HK, Momoki S, Shiotani T. Longitudinal, 2013.
23. Waves for evaluation of large concrete blocks after repair, NDT&E International 44 (2011) 61–66 Mitchell S, Moore NB, Franks J, Liu G, Xiang Y. Comparing the Results of a Full-Scale Buckling Test Program to Actual Well Data, 2013.
24. New Semi empirical Buckling Model and Methods of Reducing Buckling Effects. SPE 144535 presented at SPE Western North American Regional Meeting, Anchorage, Alaska, U.S.A. (May 7-11 2013).