BASICS OF MODERN SERVICE PACKER TOOLS SPECIALTY TOOLS FOR SELECTIVE ACID BREAKDOWN FLUID SPOT CONTROL VALVE METHOD FOR TREATING WELLBORE PROBLEMS

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BASICS OF MODERN SERVICE PACKER TOOLS

History

Packers used in oil wells date back to the earliest oil fields. The first packers were home-made and were generally a wooden plug-rag packer made by wrapping rags around a pipe, or steel wool or lead packed in the bottom of the hole with tools. Most of this early work was in open hole.

Modern completions where casing is set through, cemented, perforated and acidized increased packer usage, giving rise to packer service firms that furnish tools and service to perform a treating job on a rental basis. These service tools are patented and are not sold. Approximately 5% of workover and completion money is spent on rental packers.

This increased use of service packers started just after World War II and resulted in the development of the modern service packer and retrievable bridge plug.

Packer Requirements

A modern treating packer must have the following capabilities:

1. Hold high pressure below or above packer
2. By-pass above hold-down to equalize pressures above and below packer before unsetting
3. Method of locking by-pass open for running in and locking by-pass closed for treating
4. If tension-set, a safety release is necessary
5. Hydraulic hold-down should set from pressure below tool, not inside tubing
6. Multiple set tool with simple J-type operation preferred
7. Run and pull fast without setting, floating or dragging
8. Packer and plug to run together for selective treating.

Availability

There are no new 1973 packer models available. In this writer's opinion, this is because:

1. Customers are reluctant to experiment with new tools on expensive wells when older methods seemingly work.
2. Past experiments with new tools proved to be costly failures.
3. Dictates of company policy
4. It takes years of service to gain a customer's confidence in a new packer.
5. Well conditions may cause trouble for which the new tool is condemned.
6. It is costly to replace these old packers with tools of new design.

Listed below are three of the first modern service packers developed. All of these tools were developed over 20 years ago. Two of these tools, with no major changes, are still the most widely used and accepted tools today.

The Brown Boll Weevil Packer was the first design to meet most of the above requirements of a modern service packer. (See Fig. 1) This packer did not retain its popularity for several reasons.

The by-pass normally was run in closed, causing the tool to run slowly in fluid. Some experienced operators used to wire the by-pass open while running-in. Breaking this wire when setting tool, was sometimes difficult if too much wire was used.

Once the by-pass was opened to equalize pressure; it was often difficult if too much wire

FIG. 1—BOLL WEEVIL PACKER

was used.

Once the by-pass was opened to equalize pressure, it was often difficult to screw back in and close the by-pass when multiple setting was desired.

In addition, no retrievable bridge plug was made to run with the packer.

The manufacturer abandoned the Boll Weevil packer for another design before it was fully developed.

If the Boll Weevil packer had been improved and retained, it would have been at the top today. There are a number of oilmen today that swear the Boll Weevil packer was the best packer ever built, and they would still be running them if they were available.

The Baker Full Bore Packer and Retrievable Bridge Plug meets all modern requirements, see Fig. 2. This tool has a service record of over 20 years. No major changes have been made in this tool since it was introduced. It was built for service and not for sale. For high pressure treating below the tool, this tension-set packer with separate unloader above, is the most widely used and accepted rental tool today.

Halliburton RTTS and Retrievable Bridge Plug also has a 20-year service record, with no major changes since its introduction. (See Fig. 3) This compression-set packer and separate unloader above is especially popular on deep, high-pressure jobs that require treating and testing below the tool. The tool is built for service, not for sale.

Watson FS Series of Modern Service Packers and Retrievable Bridge Plugs also have all the capabilities necessary for a modern service tool, (see Fig. 4). They are available in compression or tension-set tools. The by-pass is built in through the tool, not separate and above tool.

A retrievable bridge plug is available to run with the packer for selective treating, (see Fig 5).

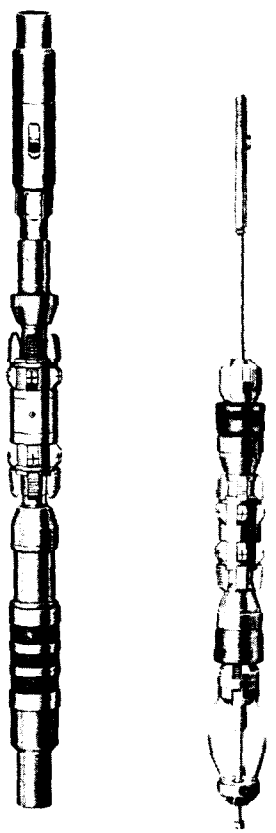


FIG. 2—FULL BORE PACKER AND FULL BORE RETRIEVABLE BRIDGE PLUG

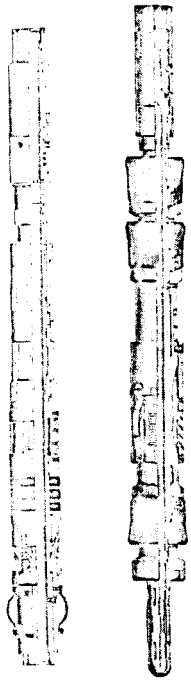


FIG. 3—RTTS PACKER AND
RTTS RETRIEVABLE BRIDGE PLUG

The FS tools are patented, built for service and not for sale. The tools are of basic design and are field-proven. They are built for customer confidence for a given area and for one customer at a time. Every attempt to avoid packer failures is made; customer confidence is of greatest importance.

SPECIALTY TOOLS FOR SELECTIVE ACID BREAKDOWN

New treating technology brings about a need for specialty tools. The following discussion contains two examples of successful specialty tools for this new treating technology.

FS-4 Straddle Packer

The Watson FS-4 Straddle Packer tool (Fig. 5), for selective acid breakdown is designed to have the following advantages.

Acid may be spotted below perforations as well as up and across perforations. No running up and down hole is required to spot acid or to retrieve plugs. The tool has a fixed amount of straddle and the close control valve on the tubing permits carrying acid in the tubing for multiple zone treatments.

The tool will move under pressure through the tubing stripper if desired and allows treatment below both packers without below valve; a ball is dropped to treat between.

Treating time and cost are cut 30%. This method is the fastest, safest and most economical means for selective acid breakdown.

To perform such a treatment, the operator should first determine if all zones are perforated and open. He should then record all breakdown, treating and shut-in pressures on each zone and check each zone for communication to the zone above.

To best check for communications, treatment should be from the top down. In treating 200 zones from bottom up with this technique, 30% communications resulted. Using the same approach, but treating from top down, resulted in 50% communications. This was proof that one does not always find out about communications up unless the zone above is broken down first.

Reports were tabulated on 6144 zones treated as to percent communication based on the number of feet of separation between zones. The results of these treatments are shown in Table 1.

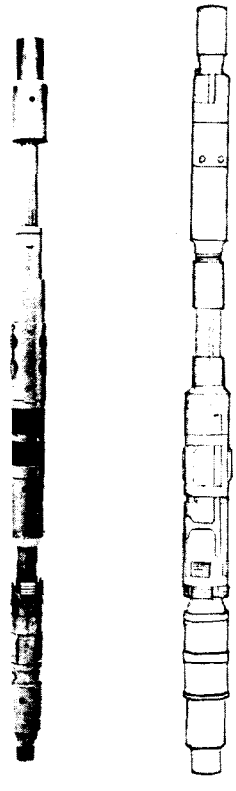


FIG. 4—FS-1 COMPRESSION SET AND
FS-1 TENSION SET

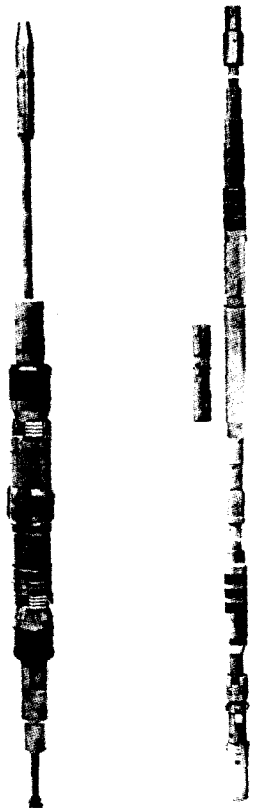


FIG. 5—FS-2 RETRIEVABLE BRIDGE PLUG AND FS-4 STRADDLE PACKER

Fluid Spot Control Valve Method For Treating Wellbore Problems

Fluid Spot Control Technique

The need for the adjustable pressure-operated spot control valve and method is apparent when considering that treatment has to be spotted in contact with scale and kept there for 8 to 24 hours. This is difficult and sometimes impossible to do without the proper tools, for several reasons.

TABLE 1

SEPARATION BETWEEN ZONES	NO. ZONES TREATED	% COMMUNICATIONS
5-35 ft	2534	73%
35-50 ft	1485	38%
50-75 ft	875	24%
Over 75 ft	1250	8%

The hole is unloaded in most all cases. Thief zones are open to take chemical, and the hydrostatic head of the flush causes problems. Zones may make or take fluid while an attempt is made to keep the chemical on the scale in the wellbore.

TABLE 2—FS-5 ADJUSTABLE PRESSURE OPERATED FLUID SPOT CONTROL VALVE JOBS PERFORMED DECEMBER 2, 1970 THROUGH DECEMBER 2, 1972

FIELD OR AREA	NO. OF JOBS
Anton-Irish Field	31
Brahanney Field	1
Cannon Ranch Area	1
Cardova Lake Field	3
Cedar Lake Field	20
Cope Unit, Reagan County	2
Cowden, North Field	15
Cowden, South Field	15
Crockett Queens Field	1
Cummings Field	1
Dunes Field	15
Empier Field	5
Forsan Field	3
Foster Field	24
Fullerton Field	6
Goldsmith Area	274
Howard County Field	1
Keystone Field	6
Landon Field	3
Levelland Area	3
S.W. Levelland San Andres Unit	13
Loco Hills Area	3
Means Field	31
Midland Farms Area	5
Moose Queens Field	6
Notrees Area	3
Penwell Area	2
Prentice Unit	6
Russell Field	4
Sealy Smith Field	5
Seminole San Andres Field	5
Slaughter Field	122
South Harris San Andres Unit	1
Smyer Field	1
Sprayberry Field	5
Vealmore Field	1
Vincent Field	1
Ward, South Field	3
Wasson O D C Field	48
Yates Field	6
TOTAL NO. OF JOBS	701

In addition, u-tubing of chemical up-hole can occur while spotting chemical across the formation. Treatment procedure often calls for slow pump rates with shut-down periods. This is difficult to maintain with a well on vacuum. Control is further complicated due to handling a relatively small amount of expensive chemical.

The APO fluid spot control valve method has been successfully used on over 700 wells, (Table 2). The downhole tools are shown in Figs. 6 and 7. The procedure used is shown in Table 3.

TABLE 3—APO FLUID SPOT CONTROL VALVE TREATMENT PROCEDURE

1. Hot oil or xylene-treat well for paraffin before taking well off pump if needed. Go in hole with FS-1 packer, with annulus to annulus by-pass, tailpipe, FS-6 shear sub and FS-5 fluid spot control valve.
2. Pre-set spot control valve to open at hydrostatic head of spotting fluid.
3. Set bottom of tailpipe below all zones to be treated.
4. Set packer above all zones.
5. Leave built-in by-pass through packer open.
6. Pump chemical down tubing followed by enough flush to fill tubing.
7. Pressure up, open valve, pump enough chemical out to displace all well fluid below packer with chemical.
8. Shut-down spot control valve closes and relieves hydrostatic head in tubing.
9. Close by-pass through packer and isolate annulus above packer from producing formation below packer.
10. Pump remainder of chemical in bottom of tubing into formation at desired rate with shut in periods as desired.
11. Close well in 24-48 hrs. Chemical should stay put as hydrostatic head is completely relieved off formation and there is nowhere for it to move.
12. Swab tubing dry.
13. Shear open 4¾-in. holes below packer with swab.
14. Surge formation.
15. Swab for desired clean up.
16. Acidize formation.
17. Pull tools out of hole and put well to pumping.

Results - Improved Control Method vs Dump Method

Results of the improved control method are compared to those of the dump or noncontrol method in the discussion below.

The success ratio changed from 20% to 70% in treating scale. There were larger increases in production. The same wells that were previously treated with the dump method had much larger production increases through the use of the control valve method. There are practically no wells presently being treated for scale without using the control valve method. In addition, more treating is now being done for wellbore problems since introduction of these tools.

FIG. 6

One operator has treated over 100 wells using the spot control method requiring only two drums of chemical per well. When asked about changing his procedure, he stated that the wells were completely de-scaled and he saw no reason for changing the procedure.

Circulating Chemical Using Spot Control

Circulating chemical with pump utilizing spot control method also has application, see Table 2. The procedure is summarized in Table 4.

There are several advantages in using this method. Field results look good so far. Circulating does a continuous washing job on the formation, removing grease, allowing more chemical to contact scale. The packer may be set high, permitting more chemical to contact scale than is possible using the spot method only. The cost is slightly higher than the spot method.

Acid Washing

Acid washing of large sections of open hole or perforated intervals is possible with the control valve using a jet sub (2-4 3/16-in. jet holes) above the valve. This allows making connection in an unloaded hole without losing acid.

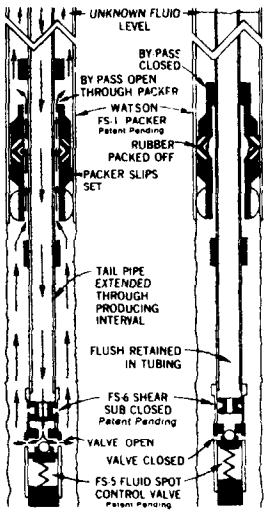
The method permits wash to take place at the desired rate, keeping acid in longer contact with scale.

Drop-type Spot Control Valve and Applications

The drop-type spot control valve has several applications. See Fig. 8. Its 1¾-in. OD will go through seating nipples. The seal assembly can be run above the valve to set the seal in the seating nipple. The entire assembly may be fished with wire line when the treatment is completed. This makes treatment possible with the control valve method without tripping the tubing.

TABLE 4—PROCEDURE FOR CHEMICAL CIRCULATION USING FLUID SPOT CONTROL METHOD

1. Run the same tools as in Table 3, adding sliding oversized perforated setting nipple immediately below packer and latch-in seating nipple with shear sleeve on bottom of tailpipe.
2. Spot chemical and displace fluid below packer and close by-pass as above.
3. Run rods with latch-in assembly and standard pump, rods for spacing, seal assembly for top seating nipple and pack off on rods.
4. Jar down and shear open ports below pump.
5. Pressure tubing and shear block-out sleeve down and open ports below top seating nipple.
6. Start well to pumping circulating chemical across producing formation. This completely closes fluid in below packer and circulates below packer only.



LEFT: Packer by-pass is open to permit placing treating chemicals opposite formation. RIGHT: Packer isolates hydrostatic head. Spot Control Valve isolates hydrostatic head in tubing.

FIG. 7
(METHOD PATENT 3,713,490)

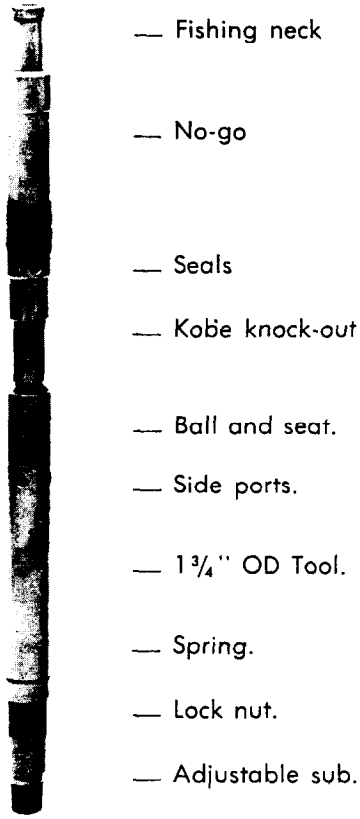


FIG. 8

Wells in the Yates field were treated in their deepened hole sections by using the drop-type valve with the outlet below new hole. Acid was pumped at a slow rate to keep acid working on new hole longer before going into older zones.

SUMMARY

There are several advantages in using service packer tools for well treatments:

1. Service tools are built using the best materials and design. Cost is not a factor in building service tools.
2. Service packer tools provide the method needed for even the most difficult job.
3. Sales packers now on the market are built first to sell, with price the main factor.
4. Service packer cost is not unreasonable if compared to the cost of dressing a double grip-type sales packer.
5. The service packer serviceman can save you money and worry by accepting the responsibility of tallying, running-in, setting, treating, unsetting, and pulling his packers safely.