IMPROVE THE QUALITY OF PUMP PROTECTION AND PUMP PERFORMANCE WILL IMPROVE DRAMATICALLY

Roy N. Moore, Vice President
Stren Company, Houston, Texas 77037

ABSTRACT

A new and patented technology has recently been introduced to the petroleum industry that reduces the lifting cost per barrel of fluid by containing the abrasive particles that damage the rod pump. This technology is a stainless steel membrane (screen), with specifically taylored micron openings. The membrane is engineered specifically to the pump manufacturers tolerance between the plunger and barrel under operators field conditions. A durable down hole pump protector can now provide more pumping days between workover cycles. Although experts agree that abrasive sand particles (frac sand or sand from the reservoir) will damage the rod pump, there has been little consideration given to understanding the micron size of particles that actually do the damage. This new technology includes a reusable stainless steel down-hole tool that allows the pump to do its work over a planned predetermined period of time with minimum damage to the plunger and barrel. Stren Company developed this special down-hole tool with a specific micron opening (15 to 75) micron) for containing the abrasives particles before they enter the pump. This engineered tolerance between the membrane and pump has proved to be the most economical approach to maximizing the pumping days for each well.

PRODUCTION IS A DIRTY JOB

In the Petroleum Industry, the most profitable enhancement program is, "Just keep pumping oil."

It would be nice if all wells flowed clean oil, say, about 32 gravity. But, unfortunately, this is seldom true. The facts are that most wells in the petroleum industry have to be pumped; and, according to scholars, "most wells will eventually go to the pump".

It would also be nice if the pump worked in only clean oil, but unfortunately, this too, is also seldom true. In addition to oil, the pump is more likely required to pump water, dirt, chemicals, gases, mud, clay, sand and all types of terra firma.

Throughout the total production industry, no one would ever allow fluid to be pumped without first protecting the expensive pumping equipment with the best filtration system available. This is standard API oilfield practice. All engines are protected with filters. Even small inexpensive water pumps are protected with filters. Mother Nature protects our body with filters. Good equipment must be protected with useful filters to insure maximum service.

Over time, the evalution of a serious effort to protect the down hole pump has begun to gain priority. It's true, somewhere down below the pumping jack is a rod pump. And the pump's most serious enemy is sand. Yet, 99 percent of all rod pumps are working today without any protection at all. As a result of no protection, a high percentage of these pump must be serviced at least once a year. In many cases the well is worked over every month. In fact, some wells only pump a few days before the pump dies. Think of the lost production when a regular short workover job turns into days waiting on a workover rig or the weather. After a while, these are serious dollars. (CHART 1)

PRODUCTION

As if there wasn't enough problems just trying to keep the field wells pumping, the operator is constantly facing an ever increasing production cost.

Most increase in production cost today comes from sand related problems. Why is the reservoir producing more sand? Why is the well being worked over at an unpredictable rate? What is causing an increasing number of rod failures? What is causing tubing, valves, fittings and other up-stream equipment to be sand cut? Where is all this sand coming from?

THE SAND PROBLEM

All the problem must not be attributed to sand from the reservoir. Some may be the lack of time to hear, to understand and to react to the message from the "in-flowing sand". By not understanding the cause of reservoir sand, the production cost of some wells may increase where only a cement plug will cure.

It is important to draw on the personal experiences that have been successful in the past. With limited budgets being allocated to the production department, the high volume wells are often worked over for maximum production. Where as, the lesser wells may be neglected in order to maintain an even "cost to production" ratio for the total field. In time, this practice proves to be seriously flawed. All wells must be profitable and each well must be its own profit center.

Again, it may be time to rethink the problems associated with sand producing wells. To concentrating on making "each well" a profit center. To better understand sandy wells. For example, if we consider each hole drilled as an invasive surgury to the earth, then Mother Nature will eternally try to heal this incision. It may take time to recover from the wound, but, in time, Mother Nature will always win. The longer we fail to stabilize the in-flow of sand on each well in the field, the longer the sand problem will affect the lifting cost.

Don't be mislead by a quick workover job to get the well back on production. This could also prove expensive. Fragile reservoirs with

in-flowing sand problems cannot quickly stabilize durability after the violent squeezing and swabbing pressures caused by an over-active workover operation. This is even more harmful when the workover operation is duplicated within a short period. Continuous workover jobs to sand problem wells is not the answer. On the other hand, long uninterrupted pumping periods have solved many pumping problems.

THE ROD PUMP

For years, the down hole rod pump has been considered the most cost effective tool for producing a non-flowing well. It pumps the oil that permits all the other field operations to function. But when the pump is run to complete destruction at the trade-off for reaching a monthly cost budget or production quota, the short term gain, if any, may prove very expensive.

PRODUCTION AND MAINTENANCE

Under ideal field operations, the production manager will always have a new pumping jack, new tubing, new rods, the best new pump available and a group of skilled field people. In todays petroleum industry, ideal operations are rare. More likely, the tubing was purchased from an auction, the rods were reinspected from the rack in the far corner of the yard, the pumping jack came from a plugged well and the rod pump has lost all identity as to the original manufacturer. In spite of all excuses, the operation, in order to maintain its present status of a field operation, must produce oil at a profit.

In a non-flowing well, the percentage value of the rod pump cannot be compared to any other piece of production equipment. The pumping jack sits securely on its foundation, the tubing is transporting the oil from the reservoir to the surface pipe line, the rods are pushing and pulling the pump for its last drop of oil and the rod pump is gasping in an hostile environment of gases, pressures, chemicals, trash and ABRASIVE SAND.

If the pumping jack has problems it immediately gets the attention of the best mechanic available. If a hole appears in the tubing, it is immediately replaced. If the rod separates, a fishing crew is dispatched immediately...but, when the rod pump has been completely chewed-up by sand, the flow of oil is down to a dribble and production people scream for a workover rig, someone says, "think we can nurse it over 'til next month?"....not likely and certainly not profitably.

As long as the rod pump is thought of as just another piece of expendable production equipment it will always come off as a distant second to the more glamorized members of the production string. But when the rod pump is identified as the only prime piece of unprotected equipment used in the entire down hole production operation, and when the far reaching effects of sand damage is translated into lost production and dollars, only then will the real financial importance of protecting the pump become a reality.

ECONOMICS AND ENHANCED PRODUCTION? - JUST KEEP PUMPING

Protecting the pump is not new. Many distinguished engineers have spent their entire lives designing better rod pumps, forging better metals, different plunger barrel configurations and designing better heat treatments. All these advances have proved to be beneficial and all resist the affects of sand...but sand still killed the pump. Why? This small venerated area between the plunger and barrel was not effectively protected from the small abrasive sand particles and the pump would not continue to do its job.

In plain and simple oilfield language, the pump is saying, "if you don't protect me from the working environment, I won't work!"

To protect the rod pump against down hole trash, frac sand and reservoir sand, Stren Company developed a membrane type screen system that is unitized directly into the standing valve of the rod pump. All reservoir fluid must now flow through the PumpGard before entering the pump. Maximum protection has been achieved and the pump will run forever...WRONG...NOTHING IS FOREVER...What ever is deployed down-hole to protect the pump, must also be serviced. (FIGURE 1)

Therefore, if the ideal solution is to protect the pump, and the ideal protector is the PumpGard, then what are the signs that indicate the pump is being protected? The answer is, "Check it out." There are many diagnostics available. For example, the dynamometer, or you can shoot a fluid level, record of the lost production during regular and specific periods, take a reading of the "sand in the fluid", and review the factual well records and workover history. The best off location check station is the pump shop. Have the shop mike and log all parts.

After using the PumpGard for awhile and the well has cleaned up, many experienced production people find they can now make production adjustments and increase the barrels of oil produced per day.

Further planning is made to workover the well somewhere in time. The objective is to schedule the workover within an estimated window...It won't last forever, you know...and it is normally better to pull the PumpGard before it goes to bypass and apply the savings in pump parts to the workover cost.

How many days, months or years the PumpGard will add to the life of the pump is unknown; however, workover history often makes the time predictable. The average is about of 3 to 10 times longer.

In time, when PumpGard cartridges begin to load up and the differential pressure across the PumpGard membrane reaches a predetermined PSI, the PumpGard must be serviced. If the PumpGard is not serviced, there is a piece of bypass "intelligence" built into the system, watching the differential pressure. When this PSI becomes critical, the bypass will automatically check the PumpGard out of the "pump protection mode".

Raw fluid from the reservoir will again flow direct into the pump, raw fluid will again damage the pump and the pump will die in about the normal length of unprotected time.

THE PUMPGARD

The engineering principal of the PumpGard is to effectively screen out the small inorganic solids and other abrasive particles, larger than the closest approach of the plunger to the barrel, before they enter the pump. Furthermore, the PumpGard must be designed to perform in the small and limited area below the pump, perform according to the expectations of the pumping industry, able to pass through the seating nipple, deployed and retrieved on the end of the pump and have an inside diameter larger than the standing valve seat. These are all demanding tasks.

TWO UNIQUE FAMILIES OF PROTECTION

THE COMPOSITE CARTRIDGE SYSTEM is a 3-dimensional matrix structure cartridge molded of a specially compounded material. This cartridge screens particles in decreasing size and manner. For example, 50 micron size particles are first trapped on the cartridge but smaller particles are allowed to pass on through. The next level of decreasing pore size particles would trap the 35 micron but let the smaller size pass. The 20 micron particles are captured next. This staged particle capture would finally allow only the 5 micron size and smaller particles to pass through the cartridge with the fluid. (FIGURE 2.) When the composite cartridges are loaded, they are removed from the mandrel, discarded properly and replaced with a new set.

GAS LOCKING ABILITY is an added benefit to the rod pumping industry, the composite cartridge will help prevent "gas locking" and increase the efficiency of the pump. This is accomplished by utilizing the specific gravity differential of the oil and gas and thus separate the gas from the well fluids at the "3-D matrix cartridge". Those familiar with the principal of coalescence with see it at work here. This allows the higher density fluid stream to enter the Pump. Dynamometer cards on file confirm these benefits.

THE PRECISION STAINLESS STEEL CARTRIDGE. This membrane is the unique application of stainless steel filament metallurgically bonded to an engineered core. When manufactured, the membrane becomes a continuous circular unrestricted area for the passage of fluid. The square inch opening of the total membrane "flow-through" area has a ratio in excess of 50 to 1 to that of the square inch opening of the standing valve ball seat. When first deployed in a well, the 8 feet long PumpGard has a differential pressure loss across the membrane of less than one PSI.

To accommodate the many conditions, the micron rating of the membrane is precision manufactured in a range from 15 micron to as large as necessary to handle the requirements. The most popular cartridges have 50 and 75 micron. (CHART 2).

These cartridges are easily removed from the mandrel, pressure washed, replaced on the mandrel and run back in the well.

QUALIFYING A WELL FOR PUMPGARD

Each well should be qualified by both the customer and the Stren representative before using the PumpGard. Qualification includes previous pump service history, bottom hole temperature, API gravity of the oil and, in most cases, a Stren sand analysis report. (Chart 3).

The ultimate well qualification is to define the real down-hole pumping problems. The ultimate solution is found when the well is producing as an acceptable profit center.

FUTURE OF THE PUMPGARD

The full potential of the PumpGard has not "caught on" as quickly in some fields as in others. This is partly because the petroleum industry has been "treated" to so many quick fixes in the past they are reluctant to fully embrace this new tool. This is understandable. It will require time. But, judging from the increasing world wide sales, PumpGard is accepted. (Chart 4).

CONCLUSION

In time, more people will become aware of the long range benefits of these enhancing production tools. Today, companies consider the PumpGard one of the most cost effective production tool being used in their long range enhancement program. This includes the planned workover program for large blocks of existing pumping wells where PumpGard is added to all pumps. This marathon pump, along, of course, with the other engineered enhancement programs, are designed to achieve longer service free production periods for the total block.

When the cost of protecting the rod pump is weighted against the
(a) accumulated cost of down hole failures and,
(b) accumulated loss of production,
especially when calculated on a yearly basis, the added cost of the PumpGard protection makes the second best option unacceptable.

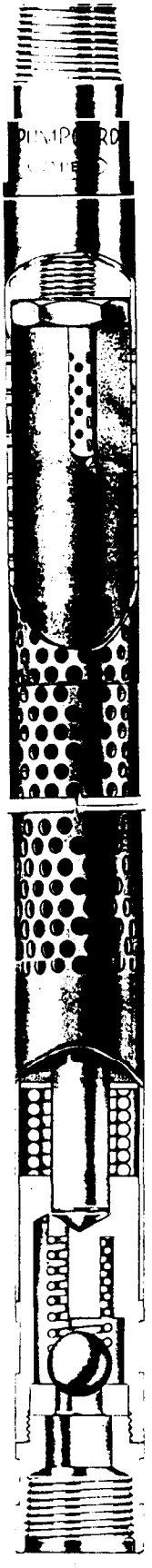
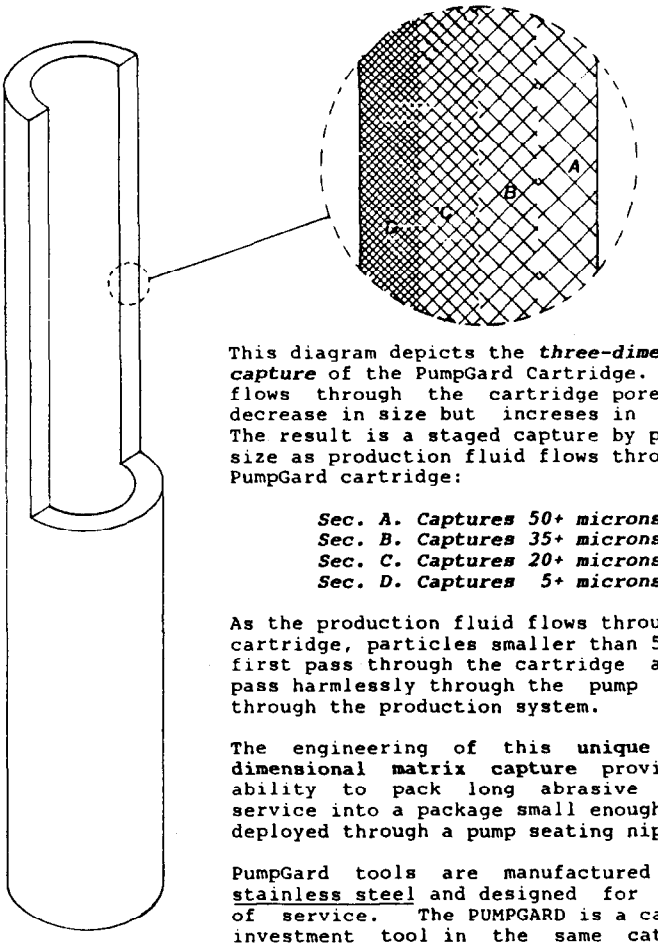


Figure 1 - PumpGard - Stren Company



This diagram depicts the ***three-dimensional capture*** of the PumpGard Cartridge. Fluid flows through the cartridge pores which decrease in size but increses in number. The result is a staged capture by particle size as production fluid flows through the PumpGard cartridge:

Sec. A. Captures 50+ microns sand.
Sec. B. Captures 35+ microns sand.
Sec. C. Captures 20+ microns Sand.
Sec. D. Captures 5+ microns sand.

As the production fluid flows through the cartridge, particles smaller than 5 micron first pass through the cartridge and then pass harmlessly through the pump and on through the production system.

The engineering of this **unique three-dimensional matrix capture** provides the ability to pack long abrasive control service into a package small enough to be deployed through a pump seating nipple.

PumpGard tools are manufactured from stainless steel and designed for years of service. The PUMPGARD is a capital investment tool in the same category as the tubing, rods and pumps.

Figure 2

Chart 1

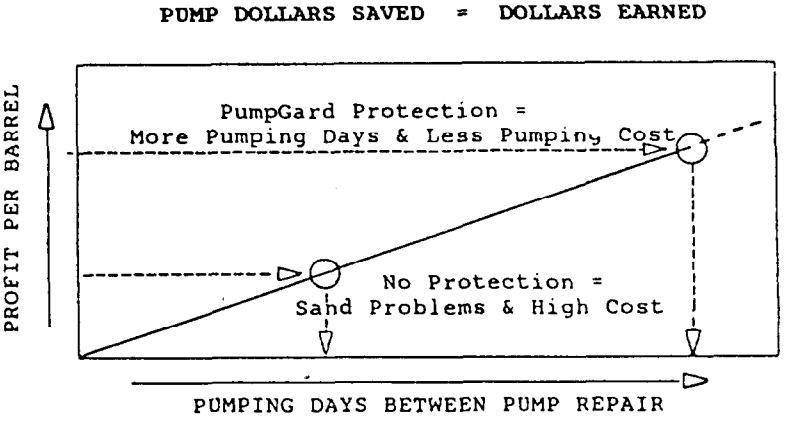


Chart 2

Conversion Chart
Standard Screen to inch to Micron

US & ASTM Std. Sieve No. (Meshes)	Equiv. Opening		
	Inches	MM	Microns
20	.0331	.841	841
30	.0234	.595	595
40	.0165	.420	420
50	.0117	297	297
60	.0098	.250	250
70	.0083	.210	210
80	.0070	.177	177
100	.0059	.149	149
120	.0049	.125	125
140	.0041	.105	105
170	.0035	.088	88
200	.0029	.074	74
230	.0025	.063	63
270	.0021	.053	53
400	.0015	.037	37
550	.0010	.025	25
800	.0006	.015	15
1250	.0004	.010	10
----	.0002	.005	5
	.00006	.002	2

Typical Proppant (Frac Sand)

Table Salt

Typical Pump Plunger/Barrel Tolerance

PGS Cartridge Control Point

PumpGard

Chart 4

Customer's Pump Records
Representative Lifting Cost Records In Various Fields

Location Customer's Wells	Has No Protection: Average Pump Repair Cycle-Days	Has No Protection: Total Pump Lift Cost/BBL.	With Pumpgard Protection: Average Pump Repair Cycle-Days	With Pumpgard Protection: Total Pump Lift Cost/BBL.
Wyoming	7	$3.734	214	$0.365
West Texas	90	2.024	496	0.540
Oklahoma	19	2.015	210*	0.965**
East Texas	37	0.680	309*	0.133**
C. La. (2 wells)	30	0.784	150	0.330
Hunt (Jena, La.)	28.3	0.2828	184	0.100
S. Texas (13 wells-Comp)		2.370	(average)	1.300
(15 wells-S.S.)		5.370	(average)	0.900

Note: This field had 6 workover rigs working every week before PumpGard, now there are only 2.

* The PumpGard is still in the well on its first run.
**The pump lifting cost is still being reduced on this well.
NOTE: "Total Pump Lifting Cost per barrel" is all cost charged to the pump, such as: workover rig and time to pull the pump, pump repair, etc. plus PumpGard cost when used.

Chart 3

WELL WORKOVER DATA AND INFORMATION REPORT

INSTRUCTIONS: (A) Make one sheet for each well. (B) Obtain factual history on well before the PumpGard was installed.
(C) Fill in the blanks with *well data* or "best-guess" information.

COMPANY NAME AND ADDRESS | PHONE / FAX

CUSTOMER NAME TO CONTACT ON THIS WELL | WELL NAME & NUMBER | FIELD | STATE/COUNTRY

PUMP MFG. SUPPLIER/CONTACT | TYPE PUMP | PUMP SIZE | TUBING SIZE | PUMP DEPTH | WELL DEPTH

DATE START PRODUCTION | BOTTOM HOLE TEMPERATURE F. | PRODUCTION FLUID - API | H2S YES - NO | PERF NIPPLE MUD ANCHOR | COST PER DAY FOR WORKOVER RIG | COST PER WELL FOR COMPANY MAN | WELL STIMULATED PROPPANT USED

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

GENERAL DATA THIS WELL — PRODUCTION DATA

REPAIR HISTORY RECORDS	DATE OF THE LAST PUMP WORKOVER JOB	TOTAL DAYS BETWEEN WORKOVER JOBS	DAYS THE WELL WAS PUMPED BETWEEN WORKOVER JOBS	PUMPING DAYS LOST	TOTAL PUMP REPAIR COST	ESTIMATED TOTAL WORKOVER COST	PRODUCTION BARRELS PER DAY: BARRELS OIL PER DAY	BARRELS WATER PER DAY	GAS-MCF PER DAY
1									
2									
3									
4									
5									
6									
7									
8									

REMARKS

STREN

TO OBTAIN AN IMMEDIATE PUMPING COST REPORT DETAILING THE BENEFITS PUMPGARD CAN PROVIDE ON YOUR WELL(S), PLEASE FAX OR MAIL THE ABOVE DATA TO STREN'S ENGINEERING DEPT. ——PHONE (713) 820-0202, FAX (713) 820-5909 ——
10115 SWEETWATER, HOUSTON, TEXAS 77037 – THIS IS A STREN PROGRAM – "HOW MUCH ARE YOU PAYING FOR SAND?" DOC759