TECHNIQUES FOR PROTECTING PUMPS FROM SAND DAMAGE

TÉCNICAS PARA PROTEGER BOMBAS DE DANOS CAUSADOS POR AREIA

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RESUMO

A bomba no seu sistema de água representa um investimento importante. Por isso, é preciso protegé-la de paros indesejáveis causados por sólidos na água.

Os problemas variam de paradas totais a desgastes graduais dos mecanismos internos da bomba. Todos estes problemas diminuem a eficiência de bombeamento e aumentam os custos de energia (Figura Uma).

A curva de eficiência de bombeamento mostra a marcada diferença entre as bombas que tem proteção contra areia e as que não tem nenhuma proteção (Figura Dois).

Existem muitas tecnologias para proteger as bombas nas aplicações subterrâneas. Este artigo analisa as mais comuns e respeitadas.

POÇO NOVO

Esta opção parece lógica no caso de poços com sérios problemas de areia. Senão, é muito custosa e demorada.

INSPEÇÃO E REPARAÇÃO

Com uma câmera de vídeo, pode-se inspecionar o poço para ver onde estão os problemas principais (Figura Três). Esta inspeção mostra as possibilidades de consertar o poço. Uma hidroprensa electrônica pode ser utilizada para consertar camisas quebradas com um "liner" sobre a área onde entra a areia (Figura Quatro).

RECAMISAR O POÇO

As vezes, se opta por uma camisa nova dentro do poço sobre a velha camisa. Mas, não se pode esquecer que a camisa nova pode limitar a eficiência do poço e requerir uma mudança na bomba.

TÉCNICA PARA CONTROLAR SUCÇÃO

Este conceito se basea na idéia que a água que entra o poço vem da área mais próxima à bomba. Para maior distribuição da vazão, pode-se instalar uma larga criva debaixo da bomba para que a sucção seja melhor distibuída.

Lamentavelmente, esta técnica tem várias desvantagens como sua fraqueza estructural e limitações de espaço dentro do poço.

PROTEÇÃO DE BOMBAS E SEPARADOR DE AREIA

A instalação de um separador de areia é uma opção viável e barata. O separador centrífugo usa a ação centrífuga para remover a areia e outro sedimento antes que a areia entre na bomba (Figura Cinco).

Separadores de areia para proteção de bombas se instalam diretamente nas bombas turbinas e submersíveis (Figura Seis). Comparada com outras táticas é muito mais econômica e eficiente. O separador de areia pode extender a vida da bomba pelo menos umas quatro vezes.

CONCLUSÃO

Uma redução em desgaste da bomba aumenta a eficiência da mesma, economiza energia, facilita a entrega de mais água e minimiza as paradas. Devido a estas vantagens, bombeiar areia não é uma opcão viável.

ABSTRACT

Sand is one of the elements most destructive to pumps in groundwater applications. Protecting pumps from sand damage is a very important issue. There are many different techniques for such protection. This paper examines such options as drilling a new well, inspecting and repairing the well, rescreening the well, installing suction flow control, and utilizing pump protection sand separators. The advantages and disadvantages of each option will discussed. Because sand damage is so severe, it is critical that at least one of the options be implemented.

1. INTRODUCTION

The pumps in your water system represent a significant investment. It's important that they operate on demand, and that they deliver a given volume of water within a reasonable period of time. You can't afford untimely breakdowns, and you need a specific minimum volume on a regular basis to meet the demands of the entire system.

Even though you have carefully chosen and properly installed a pumping system, your control of the situation often ends right there. That's because so many variables can and do significantly affect pump performance.

Chief among the elements most responsible for a pump's loss of efficiency is foreign matter in the water. A look at any pump manufacturer's sales literature confirms this concern, as these firms seek to differentiate their pumps on the basis of durability versus sand and abrasion.

Sand, silt, grit, scale, algae, organics, debris, fish, clams, and other solids or floating matter are quite simply notorious for damaging pumps and grinding away at their efficiency. Even if a well or water source has been historically reliable, factors such as drought, earthquakes, and man-made events can cause a good source to become troublesome. Your ability to recognize the need and to respond with the proper protection, can make a big difference, saving time, water, crops, and money.

What to look for--The problems range from so much sand that a pump fails upon start-up to a gradual wearing out of a pump's internal parts, causing increasing inefficiency and higher energy costs(Figure One). Common occurrences also include the fouling of residential plumbing, appliances, icemakers, and water-conditioning equipment. Valves become worn. Shower and faucet nozzles become plugged. Heating and cooling appliances (hot water heaters, heat pumps, etc.) become inefficient or damaged.

In agricultural and turf irrigation, sprinklers become worn, and their spray patterns cause uneven watering. Typical filtration systems--such as screens or sand filters--become overburdened with excessive amounts of foreign matter and demand more frequent

cleaning cycles, thereby consuming more time and water. And when surface water is the source, pump intakes must be protected from plugging to avoid pump damage or cavitation.

Even public and commercial water systems suffer from the effects of troublesome particle matter as water meters become worn, water systems become fouled, and overall plumbing and piping demands greater care, to keep lines free of potentially troublesome solids accumulation.

Few people imagine how small amounts of pumped sand add up to lots of sand over extended periods of time. For example, if one is pumping 1 liter/second with a sand concentration of 1 p.p.m. (.001 grams/liter), 2.59 kilos of sand are pumped a month. Similarly, if one is pumping 10 liters/second with a concentration of 100 p.p.m. (.1 grams/liter), 2590 kilos of sand are pumped a month.

Pumps consume energy. And this area, perhaps, offers the greatest potential for savings, and the greatest motivation for protecting pumps from abrasive wear. With today's increasingly efficient pumps-and ever-rising power costs-the value of maintaining higher pump efficiency is substantial.

Traditionally, pumps which lose their efficiency quickly (two years or less) have most always been the target for protection, if only because the frequency of shutdown and repairs was a highly visible, recurring, and aggravating event. Now, even those pumps which lose their efficiency over a period of several years can benefit from protection and maintaining their efficiency at higher levels.

The "Pump Efficiency Curves" chart illustrates the difference between pumps operating with and without protection from sand abrasion (Figure Two). As shown, when the water is sandy, the pump's efficiency drops quickly and significantly. In this example, the average efficiency over a four-year period is only 55 percent. That includes pulling the pump for service and repairs, in order to keep the efficiency from getting any worse than 40 percent.

Conversely, the pump operating with the protection of a sand separator does not suffer from the immediate effects of abrasion. Therefore, it maintains a much higher average efficiency (nearly 65 percent) and does not require any servicing or repairs. Higher efficiency, fewer shutdowns, and reduced repair and service charges are the distinct and valuable benefits of pump protection.

2. CONTROL TECHNOLOGIES

A variety of technologies have been employed over the years to control the problem of sand in a water well. This article describes those that are most widely accepted and proven effective.

3. NEW WELL

A common first reaction is that if the well produces sand, drill a new one. If it is properly designed, the new well should be free of sand.

Certainly, this option may be appropriate when it is determined that improper construction or severe casing damage is the cause of the problem. However, a new well may not solve the problem, since there are a number of other variables involved. Furthermore, a new well is not only an expensive but also a time-consuming option.

Instead of a first option, drilling a new well is perhaps more likely the last option.

4. INSPECTION AND REPAIR

Guesswork and speculation about the cause of sand can lead to improper diagnosis and ineffective repairs. A televised water well inspection can offer real evidence of a water well's actual condition. If the well is capable of being repaired, the television inspection will pinpoint exactly where repairs should be performed (Figure Three). An electrohydraulic swage enables collapsed casings to be opened so that a patch liner can be placed over the damaged section where sand infiltration is taking place (Figure Four). A follow-up survey will confirm the results of such repairs.

The ability to review and consider such visual evidence is important in deciding whether repairs are possible.

6. RESCREENING THE WELL

This technique reestablishes the integrity of the casing and gravel packaging by inserting a new well screen directly into the well. If it is properly done, this technique offers advantages similar to those of a new well. Typically, it is used to restore the productivity of an older well that has been damaged over time. Though it is less expensive than drilling a new well, rescreening the well is still a major project, requiring significant investments of both money and time.

The limitations of rescreening the well are that the well diameter is distinctly reduced and this may necessitate a reevaluation of the pump and expected yield. There is also the concern that the factors that originally led to sand infiltration are still present.

6. SUCTION FLOW CONTROL TECHNIQUE

This option is based on the theory that most water flowing into a well comes directly from the area nearest the pump's suction. To distribute the incoming flow over a broader vertical area of the well, a long, screen-like device constructed of slotted PVC piping is attached to the pump's suction. This reduces the velocity of the incoming water at any one point, which retards the inflow of sand and encourages the utilization of more of the water-producing strata surrounding the well.

Limiting this technique's performance, however, are the relatively fragile nature of its construction, the amount of required depth below the pump setting, and the concern that if sand did enter the well, the suction flow control device is susceptible to fouling with accumulated particle matter.

7. PUMP PROTECTION AND SAND SEPARATORS

Installation of sand separators in the well at the pump's suction is a viable option. Much less expensive than extensive well repairs, the sand separator utilizes centrifugal action to remove sand and abrasive grit particles from the water before that water enters the pump (Figure Five). Separated particles are purged deep into the well requiring no routine maintenance.

There is some question as to whether this technique can eventually fill the well with sand. According to the manufacturer of separators, such a situation very rarely occurs and, even when it does, the cost of bailing a well is less expensive than that of pump repairs and shutdown and the energy costs related to lost pump efficiency. Studies conducted by the National Water Well Association (NWWA) in 1985 determined that the accumulation of separated sand deep in the well actually helps distort the incoming flow of water into the well, thereby reducing the water's velocity and virtually eliminating the water's ability to carry additional sand into the well.

Pump protection sand separators are easily installed directly onto a turbine or submersible pump (Figure Six). Compared to well repairs and reconstruction techniques, sand removal is more predictable, typically extending the life of a pump at least three or four times longer.

8. SUMMARY

In selecting the most appropriate sand control technique from the options available, it is advisable to consider the following:

* Time. The more time you have, the greater are your options. For good results, well reconstruction necessitates adequate time.

* Performance. The technique selected should offer the greatest potential for long-term protection of the pump.

* Price. It is important to consider the long-term value of the technique you select to maximize your investment by reducing overall pump operating costs. Before it can save you money, the technique must work effectively. Thus, a low price may not be the most important feature.

Reduced pump wear means improved efficiency, energy savings, delivery of more water, and fewer shutdowns. In light of these advantages, pumping sand is not a reasonable option.

AGRADECIMENTOS

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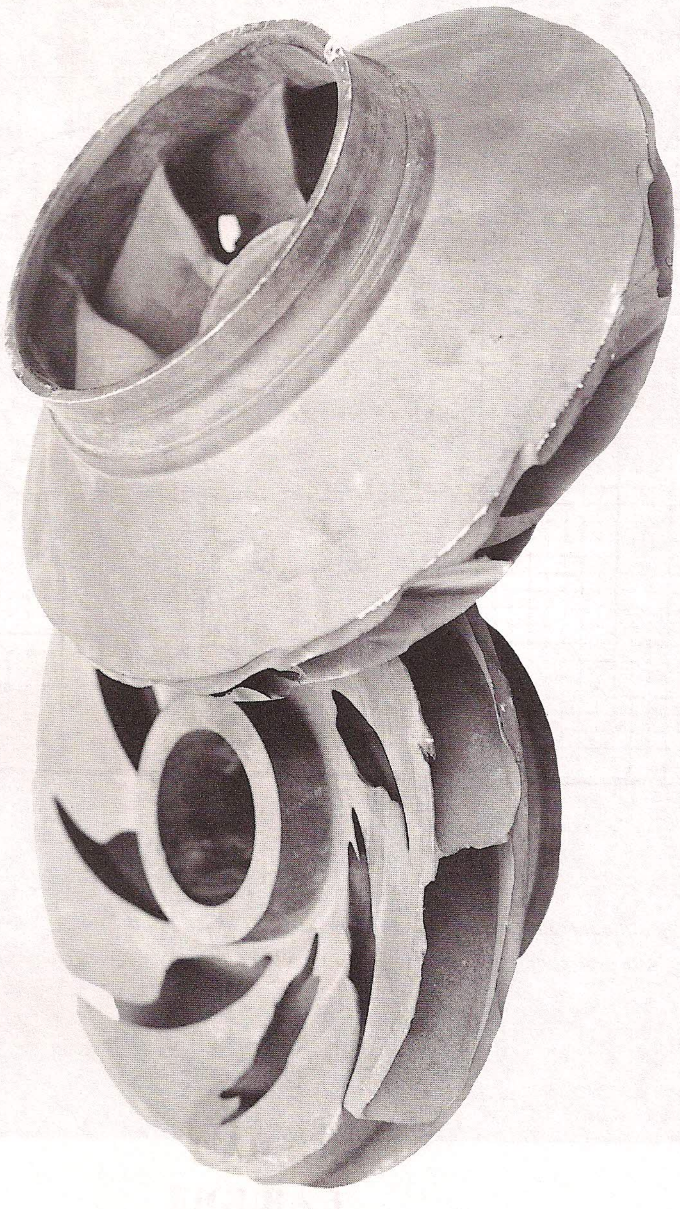
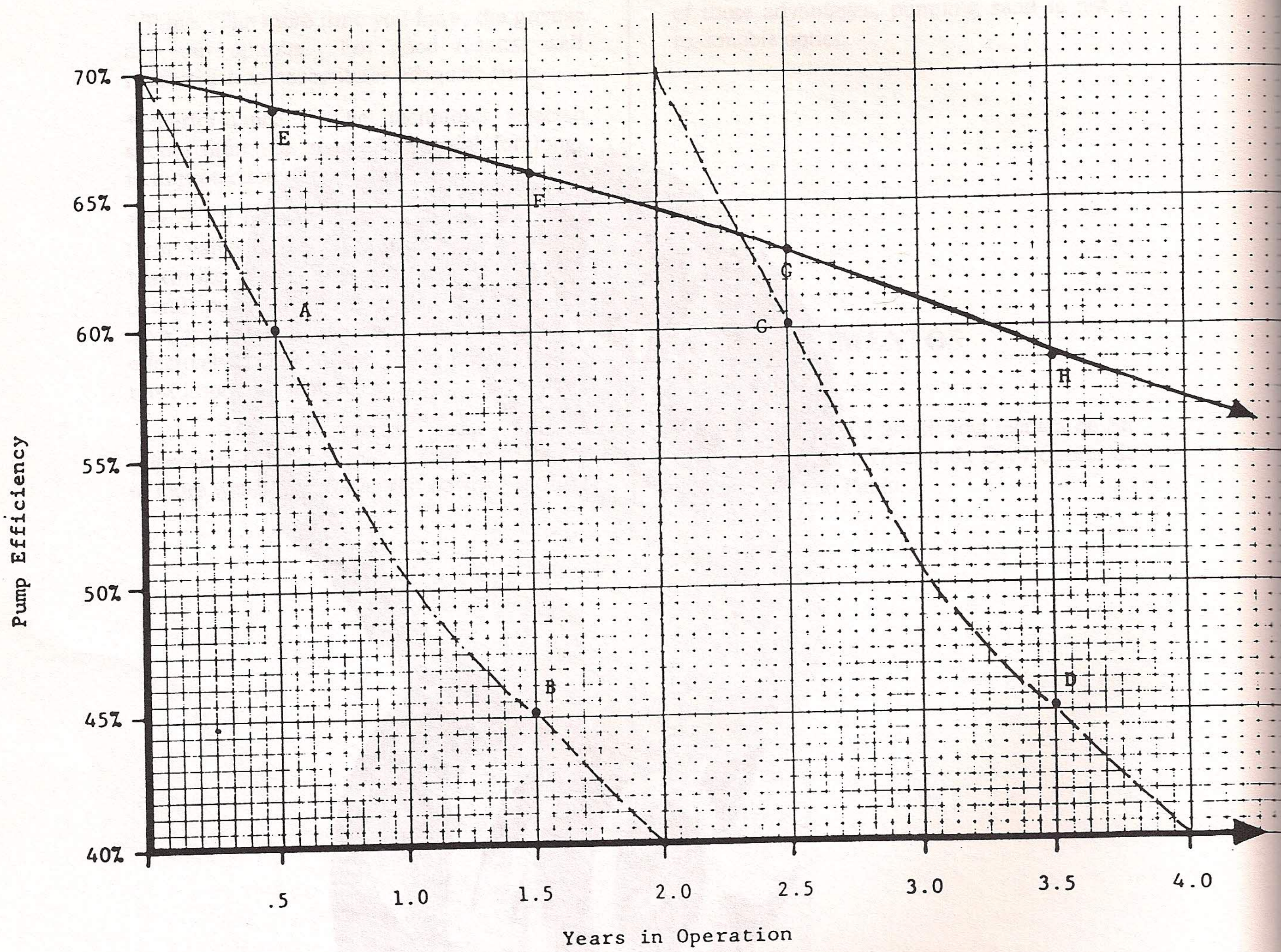


FIGURA 1

PUMP EFFICIENCY CURVES: With and without pump protection.



_ _ _ _ _ *Pump operating without protection from sand.* *NOTE: After 2 years, pump had to be pulled & serviced to restore efficiency.*

______ *Pump operating with protection from sand.* *Points A - H indicate average efficiency in each of the four years in operation.*

FIGURA 2

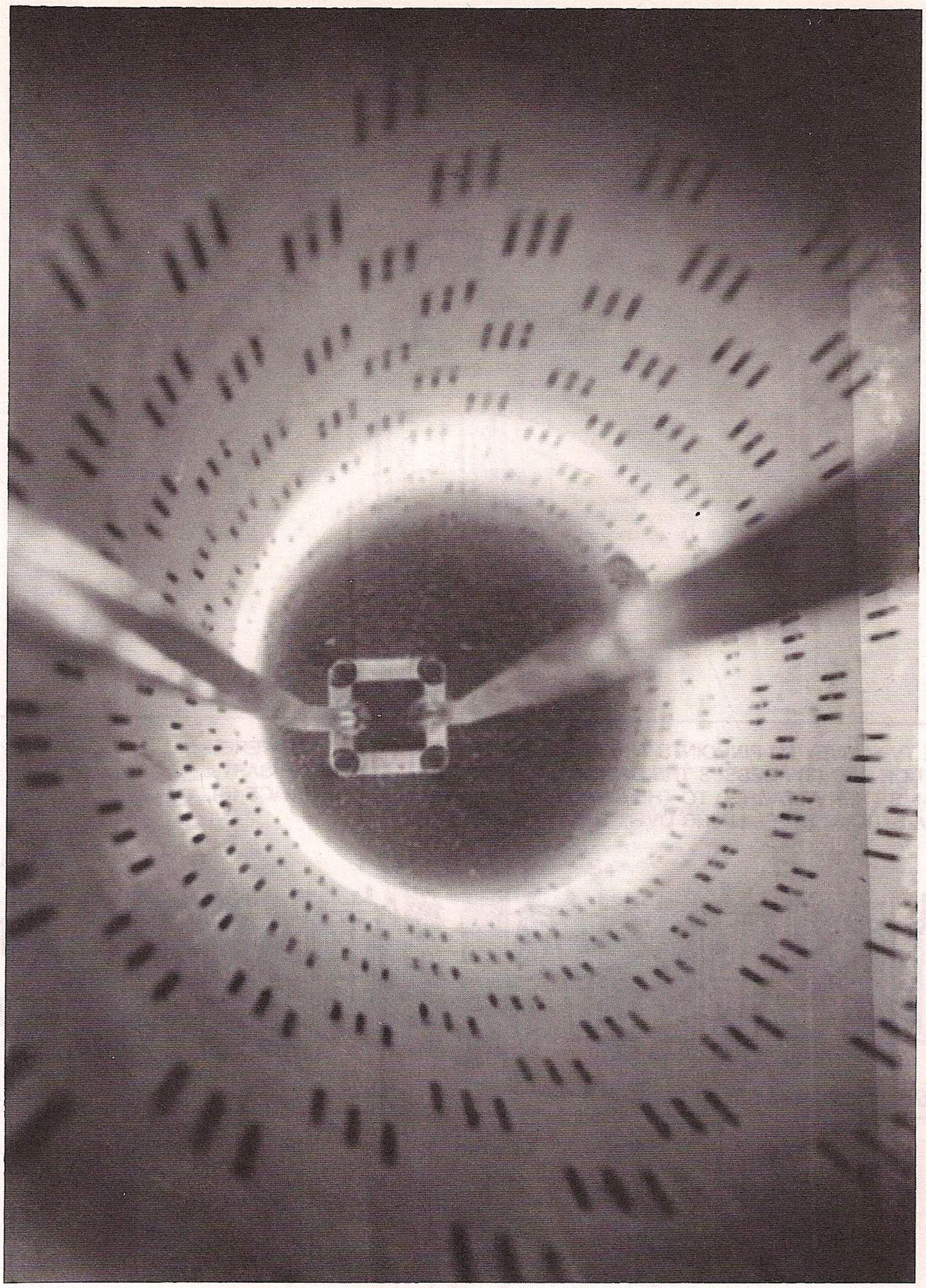


FIGURA 3

ONCE THE TV SURVEY (1) PINPOINTS THE PROBLEM, THE SWAGE (2) IS LOWERED INTO POSITION AND (3) PRESSES THE CASING BACK INTO SHAPE. IF NECESSARY, A LINER (4) IS THEN ATTACHED TO THE SWAGE AND (5) PRESSED INTO PLACE (6), FORMING A STRONG STEEL LINING OVER THE DAMAGED AREA.

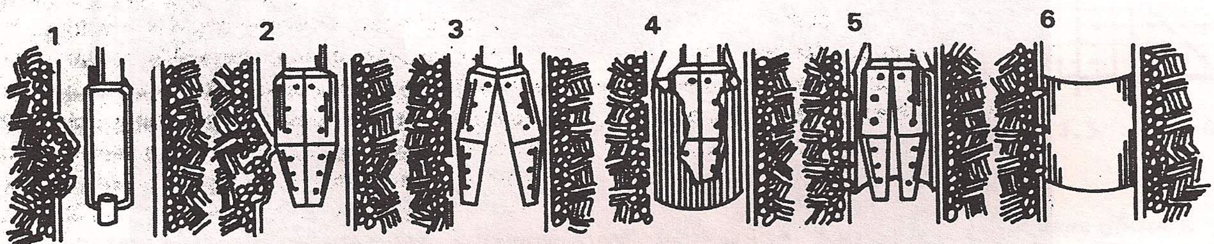


Figure 4. Swaging process used to repair a damaged water well casing

FIGURA 4

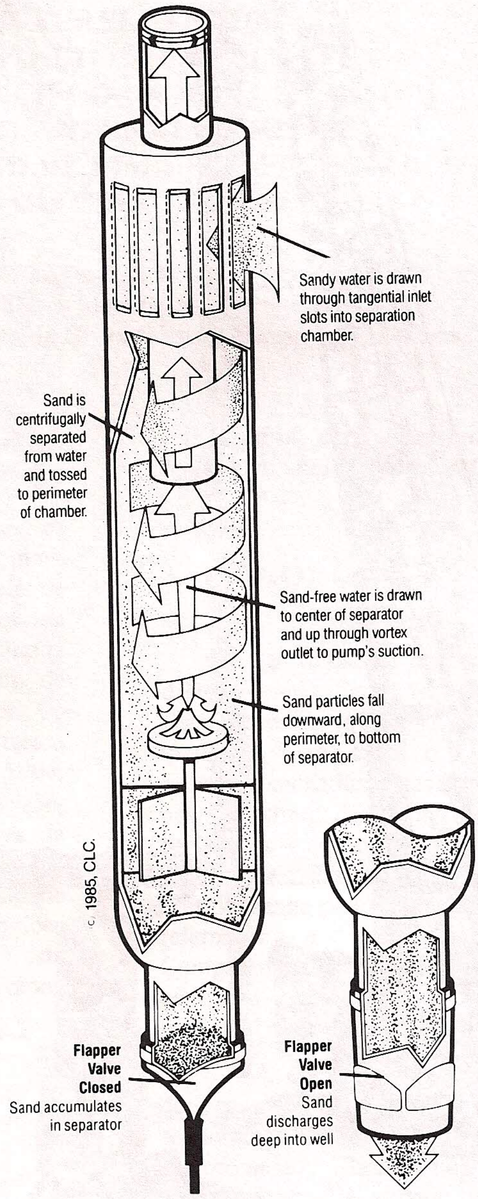

Sandy water is drawn
through tangential inlet
slots into separation
chamber.
Sand is
centrifugally
separated
from water
and tossed
to perimeter
of chamber.
Sand-free water is drawn
to center of separator
and up through vortex
outlet to pump's suction.
Sand particles fall
downward, along
perimeter, to bottom
of separator.
c 1985, CLC.
Flapper
Valve
Closed
Sand accumulates
in separator
Flapper
Valve
Open
Sand
discharges
deep into well

FIGURA 5

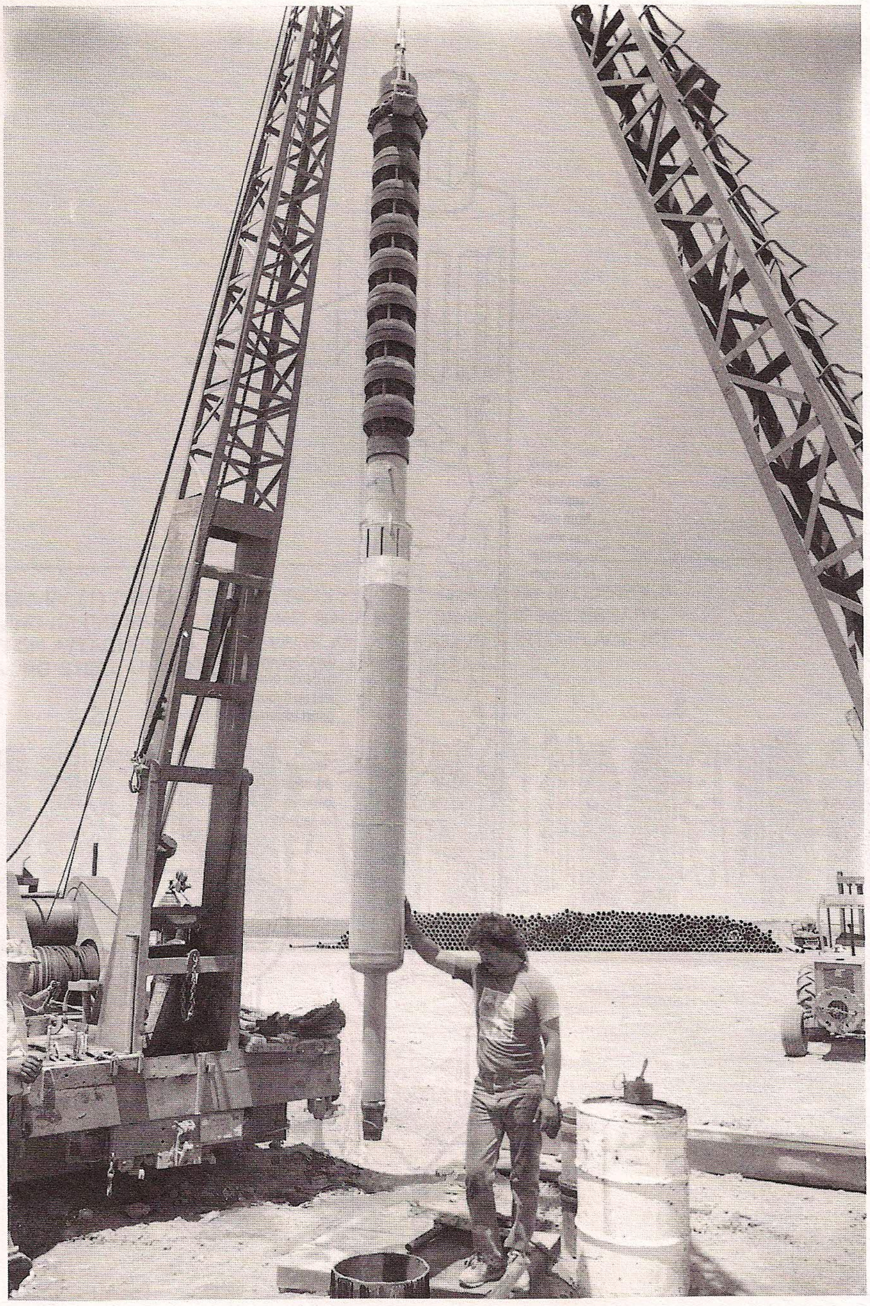


FIGURA 6