



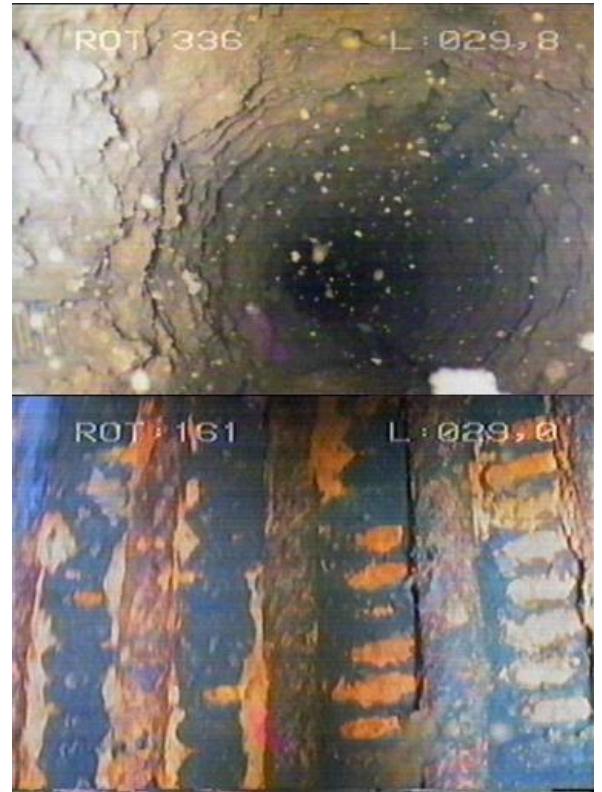
CLEANING AND RESORATION OF WATER WELLS

The well, over time, can progressively decrease the hydraulic efficiency due to fouling, mucilage etc.

This may depend on multiple factors related to chemical characteristics of water, the material constituting the captured aquifer, the screens material, working conditions and others.

There are several investigative systems to determine if the well needs a maintenance intervention and there are different types of intervention.

In this chapter we will limit ourselves to indicating which are the most used systems trying to understand their effects in a not specific way. The same intervention could achieve different effects according to how they are applied, changing for example the speeds, pressures, application time, etc.



INFORMATIVE QUOTE ABOUT MAIN INTERVENTIONS

ASSUMPTION: every intervention performed within a well, even if a few years old, involves some risks. The actual status of the piping is not objectively detectable even with a preliminary television inspection that is definitely able to give an idea of the state of conservation of the casing pipe, detect visible damages, perforations, or manifesting collapses, nevertheless is not able to detect eventual damages that are hiding under the fouling. To give another example a possible thinning of the thickness of the piping, due to flaking or corrosion not yet collapsed is not detectable with any instrument, in this case the casing strength is already compromised and a vigorous brushing can lead to a collapse of the structures. Is there for necessary that operators proceed with extreme cation, paying the maximum attention to every operation.



TECHNIQUES

BRUSHING: Is used a brush with radially arranged steel/plastic/nylon (it depend on the material of the piping) bristles. The brush, properly weighted, is moved longitudinally inside the well thanks to a steel wire rope. It is also possible to attach the brush to a hard rod joint by an appropriate head of rotation to add the rotative motion to increase the effectiveness of the cleaning. This system is indicated to remove fouling from both blank and screen pipe. In the case of continuous spiral filters (like Johnson) a "sweet" treatment should be performed to avoid damaging the screen itself. In PVC or HDPE piping is preferable to use soft bristles to avoid scratching of the wall well. The effectiveness of the treatment depends on many factors like: diameter of the brush in comparison with the well diameter, the number and the harshness of the bristles, speed and application time. Is often recommended as preliminary action before any others. It can be used in combination with other treatments like Jetting-tool and acidizing.



JETTING TOOL: Is a high-pressure cleaning system for casing pipe of wells. The tool to perform this technique has a head with properly arranged nozzles, joined with a pipe in which is pumped a high-pressure water. If the pipe is a flexible one we need a rotary hook and to slightly incline the nozzles to give the rotation at the tool, otherwise if the pipe is a hard rod, the tool is attached to a rotary head (that imprint the rotation) and the nozzles are arranged in radial position. In order to successfully perform the intervention, the nozzles need to be very close (few centimeter) to the wall of the well. Using compound nozzles can increase the coverage angle but decrease the effectiveness of the treatment. The effectiveness also depends on the flow, pressure, application time, nozzles arrangement and shape. It can be used both in the blind part and in the windowed part and in both steel and plastic pipes. It also performs a cleaning action on the gravel/draining envelope in the screens part of the pipe, this action is less performing on bridge screens. It gives Great results in combination with brushing and it is an Great preparation for other interventions.



SURGING: the term indicates the action performed by an equipment (piston) of a diameter suitable for the pipe, moved by wire rope inside the well, that produces alternate effects of depression and overpressure. To improve the hydraulic seal, the piston can be equipped with appropriate rubber seals. To create a significant increase in pressure, the body of the piston must have such weight to allow a fast-enough descent (problem solved using rigid rods and systems with pull-down). On the other side the piston with a check valve work only upward causing the depression effect. The probe normally used in percussion systems it produces quite modest hydraulic effects but can instead produce intense vibrations in the soil with effective settling of the gravel envelope.

AIR-LIFT SURGING: This technique uses a double sealing piston that work longitudinally by rigid rods. Between the two seals, long about 1 -2 meters, there is the suction grille. Above the piston the compressed air injection valve is made for trigger the air-lift. Air-lift use is subjected to some parameters requirements like suitable dynamic water level, submergence, average flow rate, air pressure, diameter of the rods and maximum flow rate. Like the surging it produces alternate effects of depression and overpressure. Benefits in comparison to simple surging are that can operate on a single portion of a screen and can immediately carry out the waste materials. Usually used to clean new construction wells and also used as final intervention after others (brushing, jetting-tools, acidizing, carbon dioxide treatment). In case of hard fouling in the well is recommended to complete other mechanical cleaning operations before the air-lifting. The effectiveness of the intervention depends from the quality of the seals and the up/down speed of the piston. In the case of Johnson type scanners, the peculiar design of the internal section, makes difficult to sealing of the seals and therefore the effectiveness is very reduced. Instead, it is improved in the case of PVC pipes.



ACIDIZING: Different fouling types requires different acid types to be removed. To be effective the acid has to act directly of the layers to be treated and the fluid must be agitated. Most common methods are: bubbling with compressed air, simple piston, brushes and in some case with some acid it can be used the submerged pump to recycling the fluid with the solution. In the unlike event of exceptionally clogged it is necessary perform a preliminary mechanical cleaning to allow the acid to act even in the gravel envelope. The effectiveness of the treatment depends from the acid type, from the quantity and concentration, from the contact time and from correct shaking. Operators must be qualified end well informed and the have to act with extremely caution. The use of acids in metal pipes involves more significant corrosion phenomena the lower the pH of the acid is. Even using appropriate corrosion inhibitors this intervention must be considered as an extraordinary maintenance. Finally, specific precautions must be taken for the disposal of surging water, the water PH must be corrected with basic chemicals to be allowed to discharge waters in sewage network.

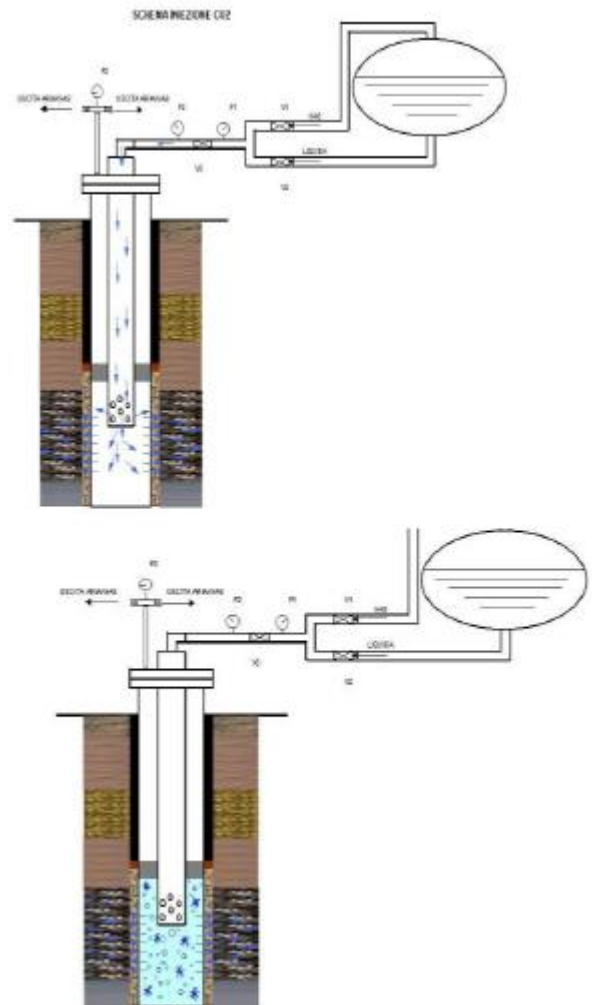


BACKWASH: Appropriate techniques reverse the natural flow of the well. Alternating backwash and purge actions fine fractions that may have clogged the drain are removed. The technic used to reverse the flow depends from: static level, diameter of the well, flow rate etc. Sometimes it can be used the water column in the well to push outwards with an air compressor, this system involves considerable risks for operators, indeed, a significant amount of compressed air can be accumulated inside the well generating forces that, in the event of an accident, can be released without any control. The well in this case behaves like a pressure pit and is not a rare event such as the sudden expulsion of the packer or of the wellhead.

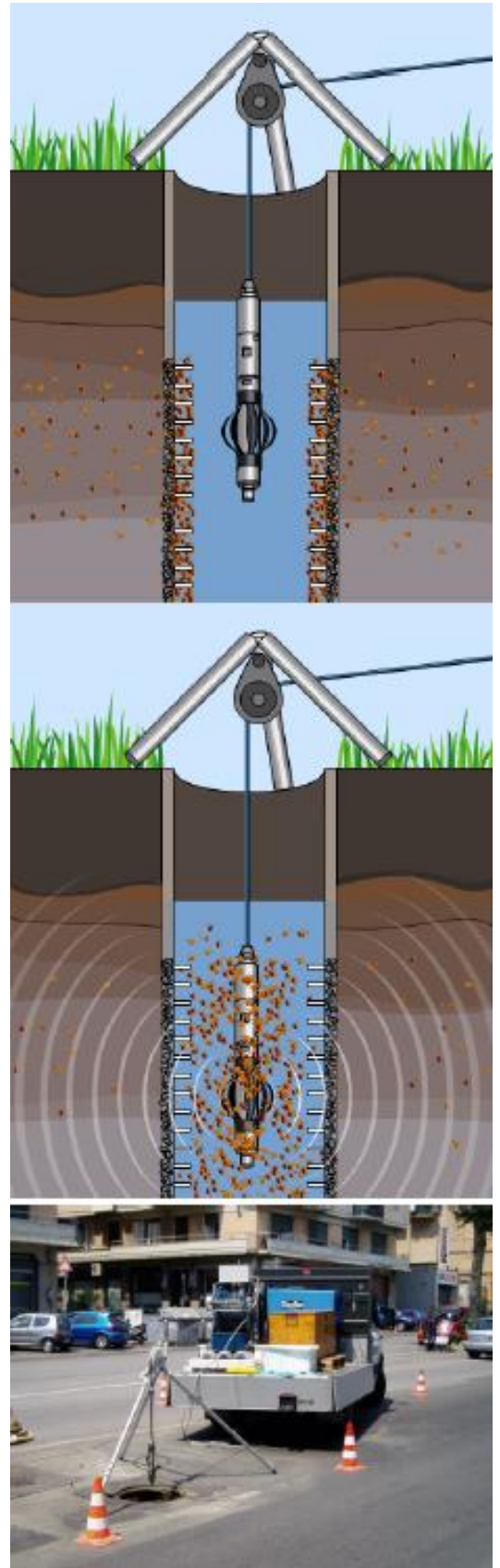


CARBON DIOXIDE TREATMENT: Consist into injection in the well of liquid and gaseous carbon dioxide. CO₂ is transported in pressurized and thermally insulated tanks. The transportation pressure is usually between 10 and 20 bars and inside the tanks there are both liquid and gaseous phase, the liquid has normally a temperature between -20° and -30° and a higher pressure than the water. CO₂ is injected through a pipe in the well, in the drain and in the narrow aquifer. A part of CO₂ in contact with the water chemically reacts by producing a carbonic acid ($\text{CO}_2 + \text{H}_2\text{O} = \text{H}_2\text{CO}_3$), that is a soft acid that is highly effective on calcareous fouling (reacts with carbonates producing water-soluble bicarbonates), iron-oxidizing bacteria etc.

The other part turns solid and became dry ice. The water in the well and in the draining, tends to ice increasing its volume and allowing to break up blocks and compacted areas. Carbonic ice solves fine parts that compact the drain. Low temperatures reached, combined with the considerable increase in oxygen concentration, perform an effective bactericidal action eliminating, in addition to bacteria, algae, mucilage, mushrooms, etc. At the end of the process the water keeps shaking due to changing phases. The effectiveness of the treatment with CO₂ is due to the progress of three different type of actions: physical, chemical and mechanical type; and also, to their continuous and energetic renewal through status changes, temperature changes and pH changes. To improve the effectiveness of the intervention it is necessary to perform a preliminary brushing and eventually develop the well with a with air-Lift pumping. The purge waters have a minimum pH of 5.5 and can be raised without adding any components basic, simply waving the waters before the disposal. It is not applicable in PVC and HDPE pipes.



HIDROPULS®: It's a technique that involves a hydraulic impulse to increase or restore the hydraulic efficiency of the water well. The basic principle of impulse production through the sudden expansion of a highly compressed gas, it is applied with various functions since the early fifties, both in seismology and in extraction of petroleum. Hydraulic shock waves are produced thanks to a pulse generator connected to the pressure chamber and inserted in the well that produces input of portions of high pressure gas that disrupts fouling mucilage, iron bacteria, etc. The pulse generator is equipped with a valve system able to free in a very short time (thousandths of a second), through the opening of large transverse cuts, the energy stored in the generator in the form of highly compressed gas. Shock highly elastic waves are produced. At the same time, due to the sudden change in volume, is generated a cavitation effect that leads to formation of an air bubble that produces a hydraulic suction due to its own collapse. The alternating effect of high and low pressure lead to the dissolution of the fine slag, of the dirt, of the impurities, etc. present in the screen, in the drainage and in the aquifer. The dissolved residues are carried by the hydraulic vortex created towards the well and then here purged with the pump. Being able to change working pressure, rooms of accumulation and frequency of impulses, allows the system to become suitable to PVC and HDPE pipes. Extremely quick and versatile, it is an instrument usable for ordinary maintenance. The large range of action, over 10 meters, makes it Great in the barrier wells in the environmental field.



Each operation produces a different effect. The choice of operations depends on multiple factors such as construction materials, diameters, depth, land lithology, type of fouling, age of the well, use of water, time and space available, etc. Attached to this information note you will find n ° 2 example tables.