COTEY
CHEMICAL
CORPORATION


agricultural


industrial


municipal


residential

Brad Cotey
Founder, 1949

Water Well Development, Rehabilitation and Maintenance Solutions

CONTENTS

INTRODUCTION

Cotey Chemical Corporation was founded in Lubbock, Texas in 1949, by Mr. Bradford J. Cotey. Our mission is to provide products that can be safely and easily applied by non-technical personnel to maintain, develop and/or sterilize all types of water wells.

For the last 60 years, Cotey Chemical has earned a reputation as a leader for developing superior water-well chemical products. Satisfied clients, throughout the United States and many foreign countries, attest to the claim of Mr. Cotey's motto - "BETTER WELLS WITH COTEY CHEMICALS".

This manual was written to provide guidance when using Cotey Chemical products. All the data has been gathered from actual experiences, but the particular suitability for specific applications should be substantiated by each user's tests.

Neither Cotey Chemical Corporation nor any of its agents can guarantee specific results or assume obligation or liability in connection with data provided.

TESTIMONIALS

"Cotey Chemical has been providing products and services to our company for the past eight years. As a result we have increased our services to our customers with excellent results and profits."

Sergio A. Leon Zamudio
Pozos Dinamicos, S.A. de C.V.
Hermosillo, Sonora, Mexico

"Cotey Chemicals work better in our area than any other brands we've tried. As far as we're concerned they are the best on the market."

Don Duerst
Duerst Machine Works
Burlington, Colorado

"We've been using Cotey Chemical products since 1960 and have been very pleased."

Bill Swaringen
Brownfield Irrigation
Brownfield, Texas

"We've recently constructed an 8" municipal well that produced 80 GPM - 500' depth. During the grouting, approximately 70 bags of cement ended up in the well and blocked all water from entering the well. We used Dry Acid Special three weeks after grouting and restored yield to 80 GPM. Valley Drilling Corporation of Virginia will be using Cotey Chemical products for all well cleaning."

Dennis W. Singhas
Valley Drilling Corporation
Upperville, Virginia

"I am confident in the integrity of Cotey Chemical Corp. and trust their products."

John Bonsangue, R.G.
Hydrogeologist
Orange County Water District
Fountain Valley, California

CHEMICAL INVESTMENT PAYBACK

In order to appreciate the undeniable value of a clean, efficiently-performing well it's important to first remember some facts about water well production.

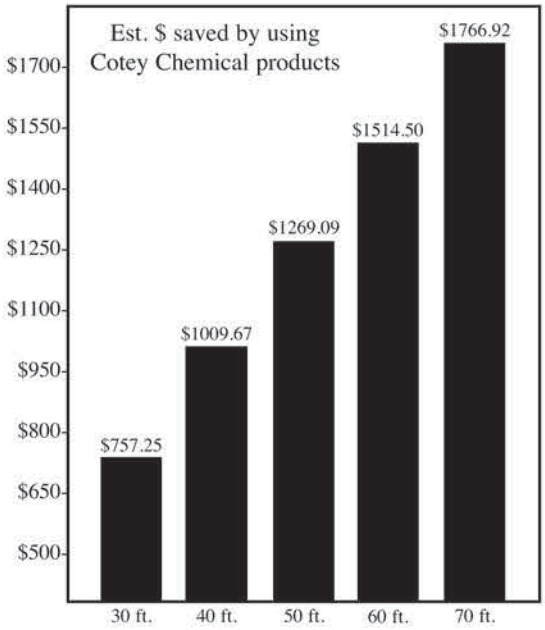
When a pump is turned on, the water in the well "draws down" a certain distance. This water draw down, added to the normal static depth of the water (the distance from the ground to the water surface), becomes the total distance the pump must lift water to the surface. The greater the lift, the harder the pump must work and the higher the energy cost. It makes good economic sense, then, to keep the draw down as low as possible.

The question then becomes, how can the draw down be effected? The answer to that question begins with the condition of the water-bearing formation and, when in place, the well screen and gravel pack.

While water is being pumped out of the well, more water is pouring in (recharging), usually through the well screen, gravel pack and the formation itself, replacing that being pumped out. Normally if the water pathways are clear, the well recharges quickly and the draw down is minimal. But, if because of well screen and/or water-formation plugging the water pathways are blocked, the well can't recharge as quickly as it should, increasing the water draw down, adding to the work load of the pump and raising fuel costs to produce the same amount of water.

Cotey Chemical has known, since 1949, that water pathways can be cleared with Cotey Chemical products. When pathways are unobstructed water flow is restored and the well recharges more quickly. Keeping a well clean will reduce energy costs, reduce wear on the pump and increase the life of the well.

One of the most immediate benefits is lower energy cost. To give an idea of the impact Cotey products can make on energy savings consider the following example: Assume a well is pumping 300 gpm with 300 feet of lift. The annual electric cost, according to the chart below, will be about $7,575.55 to produce 110.48 acre-feet of water. If, however the formation and well screen are cleaned with Cotey Chemical products, the water lift will decrease. Let's say it decreases to just 250 feet. This causes the annual fuel cost to decrease to $6,313.46. That's a savings of $1,262.09 per year. When adding lower wear on the pump, higher pump efficiency and other cost effects it's easy to see that an investment in Cotey Chemical well-cleaning products will not only pay for itself in one year, but will continue to add value to the well year after year. Moreover, developing each well to its maximum potential using chemical well treatment may reduce the total number of wells needed for a particular job.



This graph shows the additional annual electric fuel cost for each additional 10 feet the pump has to lift water out of the well. Or stated another way, this is the estimated dollars saved by using Cotey Chemical products. (see table for calculations)

Energy use and electric fuel cost of pumping water

GPM Well	(Q) Water lift in feet	(X) Annual fuel cost in $US	Additional 50ft lift	Resulting annual fuel cost in $US	Additional annual fuel cost	(Y) Assumed overall pump efficiency	(Z) Annual acre-feet of water produced
100gpm	150ft	$ 1,646.99	200ft	$ 2,194.63	$ 547.64	34.35%	36.83
300gpm	250ft	$ 6,313.46	300ft	$ 7,575.55	$1,262.09	44.79%	110.48
500gpm	350ft	$14,181.82	400ft	$16,209.19	$2,027.38	46.52%	184.13
750gpm	400ft	$22,872.98	450ft	$25,730.01	$2,857.03	49.46%	276.20

Assumptions:
2000 hour average annual pumping season
$0.10 power cost per KWH
1.024 KWH required to lift 1 acre-foot of water 1 foot at 100% overall efficiency
1 acre-foot = 325,851 gallons
(((1.024 x Q) x 0.075) / Y) x Z = X

Data provided by High Plains Underground Water Conservation District No. 1

WATER WELL CHEMICAL TREATMENT

Any water well can be treated with any number of chemicals at any time, but such treatments do not necessarily benefit the well or increase productive capacity. For example, new water wells developed in crystalline rock (granite, diorite, monzonite, ...etc.) can seldom be improved by acid treatments, and no chemical can increase the production of wells that have simply pumped all of the available water. It is therefore important, when considering a chemical stimulation program, to correctly identify the reason(s) for the decreased well yield. Cotey Chemical personnel will gladly help you with such problems.

Decreased water well yields may result from many independent, or several contributing factors. The proper steel may not have been used during well construction and considerable corrosion of the well screen or casing may have occurred. Pumping velocities may have been excessive, or a poor gravel-pack construction may be allowing too much silt and clay to pass. Well yield may decrease because of movement in the well screen or casing, or because of incrustations of calcium carbonates and iron and manganese hydroxides/hydrated oxides and bacterial slimes, or because of simple silt and clay plugging. Most of these problems can be successfully alleviated be chemical treatments - particularly by using products developed by Cotey Chemical. By the way, many contractors believe that recent developments of various exotic metal alloys and plastics for well casings and screens prevent incrustation problems. But studies document that plastic screens and even fiberglass pipes do experience incrustation problems in many areas. Thus, let's examine each of the principle clogging mechanisms, the recommended treatment programs needed for correction, and specific Cotey Chemical products.

First though, a word about the time necessary for good chemical treatment of a water well. The speed of almost any chemical reaction is more or less proportional to the temperature. Thus, warmer water increases reaction time of Cotey's chemicals and decreases well "down time". Unfortunately, in most cases, well water will be cool (< 60 degrees F). Therefore the time needed for adequate chemical treatment may seem unusually long and is sometimes cut short by impatient landowners, drillers or service companies. This is, of course, tantamount to using the wrong chemical or less than required amounts of the right chemical, either of which is bad business for all concerned. Cotey therefore recommends that if the well cannot be shut down for the needed time period, the chemical treatment should be postponed until the required "down time" can be scheduled.

This catalog attempts to outline the various specific uses and applications of Cotey Chemical products. The use of complex chemical equations, technical terminology and involved reactions is kept to a minimum although a certain familiarity is required for a competent knowledge on the part of representatives, service companies, and local advisory personnel. Cotey Chemical realizes that wells often exhibit what might be termed "individual idiosyncrasies". Therefore Cotey encourages product users to contact the company for technical assistance. We can also supply professional supervisory personnel for developing large, deep wells or treating a large well field.

WHAT MAKES A GOOD WATER WELL

There are three main ingredients that go into making a good water well: drilling, pumping and developing. The first two are indispensable since an opening of some kind has to be made in the water-bearing formation and some means must be supplied for lifting the water to the surface, even if it's only a bucket tied to the end of a rope.

Various drilling methods may include: direct and reverse circulation, rotary, cable tool, scow, driven points and even hand dug wells. Added to this we have: running the casing, setting the screen, strainer or liner, cementing, undereaming, gravel-packing and all other work done in connection with the construction of the hole.

For pumping we can include all means of artificial lift, such as deep well turbine, jet, rod, submersible, centrifugal and other pumps. We can also include air-lift and natural artesian flows.

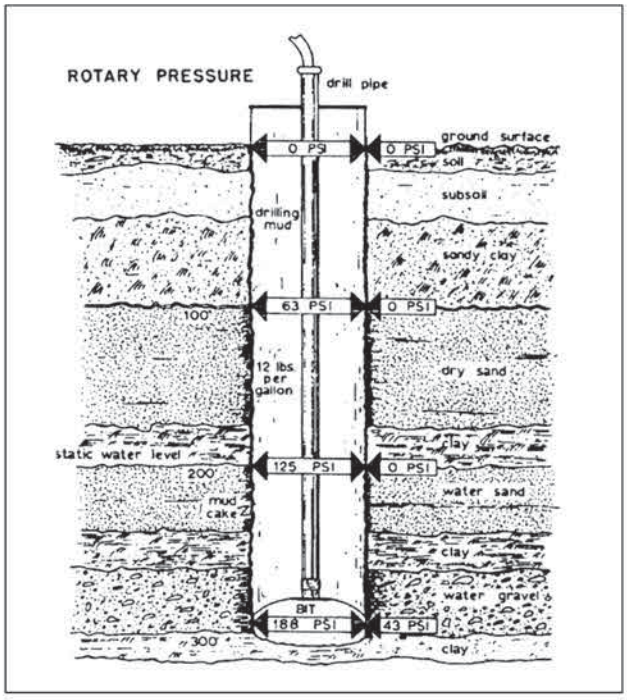
The third ingredient, the development of the well, is too often neglected. For example, wells are drilled, a pump installed and whatever flow obtained is accepted even though it may not be what is needed or desired. Many conclude that this is all the water available from the formation. Our experience at Cotey Chemical reminds us that this conclusion is probably not true and that the flow could be increased with proper development.

DEVELOPING THE WELL TO ITS MAXIMUM CAPACITY

Mechanical methods used for developing water wells include: bailing, pumping, back washing or back lashing with the pump, surging with a surge block or with compressed air, using explosives, jetting, and fracturing. In all these mechanical efforts to open up the perforations by force, pressure is applied from the well bore out into the formation. This is the same direction pressure was applied during the drilling operation, plugging some of the water pathways in the process.

In order to drill, a fluid is usually circulated to remove the cuttings and stabilize the hole. In most cases mud is considered the fluid of choice. Commercial drilling mud can be purchased and used for this purpose. Or, as happens in many wells, enough natural-occurring clay exists in the formation to form the needed mud as drilling progresses. Mud should also be the proper type and consistency. If the mud is too thin, circulation may be lost and all the mud will go back into the formation making it difficult to remove later. If the mud is too thick it becomes heavy and harder to circulate and will tend to stick the bit.

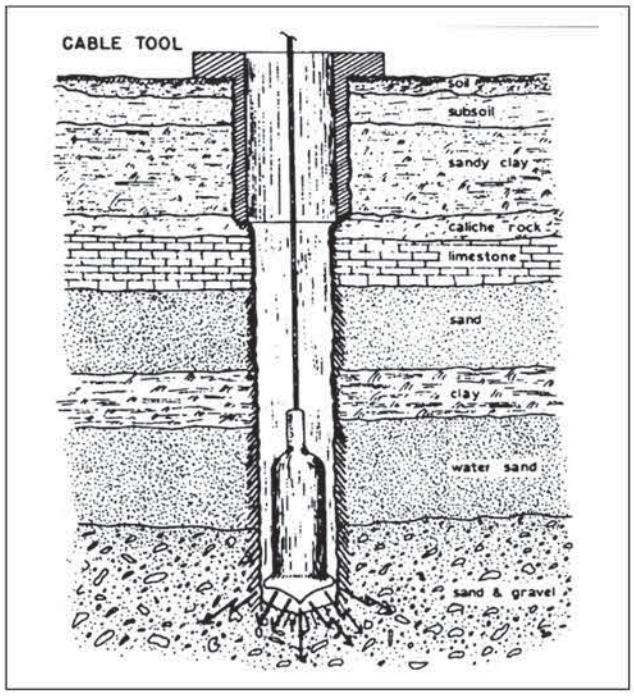
The "Rotary Pressure" illustration shows some of the results when a well is drilled with the rotary method. These will occur whether the drilling is by direct or reverse circulation. When considering the pressures and methods used to drill it seems apparent that, for all practical purposes, it is almost impossible to drill a well without plugging off at least some water.



After the well is drilled all the mud cake must be removed if the well is to be developed to its maximum capacity. According to the illustration, at the static level of 200 feet, mud was put in place with 125 psi pressure; at 300 feet, 188 psi. After most of the mud has been removed from the well by bailing or pumping there is normally some left on the wall of the hole and in the formation. The only available means to push the mud off the wall and/or out of the formation is the head pressure of the water in the formation. At the static water level of 200 feet there is no head pressure. At 300 feet the maximum pressure would be only about 43 psi and this is only if the formation had uniform vertical permeability - which is rarely if ever found. There usually will be several clay or shale breaks which will reduce the total pressure.

So we now have the following condition - mud put in place under 125 psi at the static water level and no water pressure to remove it, and mud put in place under 188 psi at 300 feet with at most only 43 psi water pressure to push it out. Naturally, the deeper the hole and the less standing water there is, the greater the differential pressure.

With cable tool or spudder drilling, the same thing occurs but the pressure is applied in a different manner. The "Cable Tool" illustration shows roughly what happens. As the heavy tool is raised and dropped a tremendous force is developed on the face of the bit. This force acts in a direction at right angles to the face of the bit. As a result, as drilling progresses, the formation around the well bore is compacted and the mud and slush in the hole is pounded back into the formation. Here again, the only pressure available to remove any plugging is the water head pressure in the formation. This pressure will never be anywhere near the pressure used by the heavy tool string. Scow drilling, driving casing and reaming also have similar action which tends to plug off some water. The effect of this plugging is lower water flow and lower specific capacity.



In a sand and gravel well, mud-cake ends up on the wall and in the formation compacted around the well bore. Since this is behind the casing or screen and behind the gravel pack, purely mechanical means will not be effective in removing it. In order to get maximum capacity all the mud must be removed and the formation opened up to allow water to flow freely from the formation into the well bore.

The combination of properly-used chemical treatments and mechanical agitation methods are quickly gathering acceptance as the most effective process for removing mud and opening perforations and water-bearing formations.

Recognizing this, a great many chemicals have been dumped into wells in an effort to clean them up. Various acids have been used, soaps, detergents similar to household cleansers, water-softening chemicals, chelating agents, wetting agents, carbide and, believe it or not, Alka-Seltzer.

But, for a chemical treatment to work, the chemistry must match the problem. For example, some chemicals must be effective in dissolving, disintegrating and dispersing commercial drilling

muds, clays and shales so that they can be easily bailed or pumped to waste. Others should be capable of dissolving limestone and water-deposited scales, corrosion products and organic growths.

Additionally there are requirements that any chemical should meet if it is to be used in a water well: It should be relatively non-toxic and should not contaminate the water; it should be safe to use on mechanical equipment in the well; it should also be safe and easy to handle. Finally, from the contractor or well service company standpoint, chemical treatments should be services that can be performed without the need of additional equipment.

With chemicals that have been developed specifically for treating water wells, it's now possible for a contractor or well service company to include chemical treatment along with their other services, adding additional profit to a job and making a better well for the customer.

Finally, before any chemical treatment will even be considered, the fact must be admitted or established that some water pathways were probably plugged during drilling. Some drillers may be reluctant to admit this possibility, considering it a negative reflection on their ability. Others claim that if the water is there they will get it. This is not always true. Many older wells made more water after chemical treatment than when first completed, showing that some water pathways had been blocked from the beginning. Obstructed water pathways is often just a function of drilling and bears no reflection on the drillers ability.

DRY ACID® is a Cotey Chemical product specifically blended to help develop water wells to their maximum capacity. It is designed to remove clays, shales, drilled cuttings and commercial drilling muds from water wells. It is also excellent for "gravel-slipping" and freeing stuck drill pipe. DRY ACID® will effectively prevent mud-cake build-up if used during well drilling or will quickly remove mud-cake after the well has been drilled. Also, DRY ACID® is better than the often-used canister of single phosphates thrown down the well to "clean out the muds". This is because single phosphates act as a food source for algae and there's nothing in the phosphates that will control this algae or sterilize the well. DRY ACID®, besides simply dissolving mud and attacking carbonate content in the well, will also completely sterilize the well, certainly a tertiary benefit of major importance and at minimal cost.

After the well is completed, DRY ACID can be used to break down whatever "mud-cake" is produced during the drilling operation. This mud-cake, consisting of fine silts and clay particles, is often partially cemented or consists of minute calcium carbonate fragments. Standard treatments using acid may aggravate rather than correct the problem. The acid-dissolving cations present in the clay allow free silicone dioxide (Silica, SiO2) to precipitate out as a gel instead of dissolving it. DRY ACID not only dissolves the mud-cake but acts as a strong sequestering agent preventing silt and clay particles from precipitating or flocculating out of solution. DRY ACID may even be used to redevelop older wells produced in sand and/or gravel formations to their original flow or greater.

For wells developed in areas where carbonate is not a problem, mud-cake, silts and clays and even oil from oil-lubricated turbine pumps can be removed with Cotey Chemical's MUD-NOX. MUD-NOX is a superior wetting agent and emulsifier that disperses silts and clays, allowing the particles to be pumped to waste instead of collecting in the well. The emulsification properties ensure that any oil in the well will mix with the water to be pumped to waste. MUD-NOX also disperses mud during the bailing process and may be used as a drilling additive to reduce solids build-up,

decrease friction, aid in suspending solids and help remove mud-cake, silt and clay from the well during the drilling process.

As a multi-purpose surfactant/polymer with a broad range of useful applications, MUD-NOX is an excellent addition to Cotey's DRY ACID for getting all the water possible from the drilled well.

COMMON WATER-PLUGGING PROBLEMS AND COTEY'S SOLUTIONS

Calcium Carbonate Scale

Probably more water wells experience decreased yields due to incrustations of calcium carbonate (CaCO3) or calcium magnesium carbonate (CaMg(CO3)2) than from any other type of incrustation. Carbonate scales form mainly in water wells producing from hard water aquifers in hard water areas of the United States.

Acids vigorously attack hard water scales. The two most commonly used acids in the water well treatment industry are muriatic (hydrochloric acid, HCl) and sulfamic acid. Sulfamic acid is the basis for Cotey Chemical's DRY ACID® SPECIAL. HCl is one of the basic chemicals used in Cotey Chemical's LIQUID DESCALER.

Contractors use HCl (muriatic acid) in wells plugged by carbonate scales usually because of its availability, cost and because it dissolves most hard water scales aggressively. However, because of the absence of inhibitors, the possibility of "blowouts", and various safety precautions that should be followed when using HCl, Cotey Chemical strongly discourages using HCl alone.

The result of injecting gallons of HCl (muriatic acid) into a water well drilled through or into limestone and/or dolomite is often a "blowout". A "blowout" is when the acid and water mixture in a well "blows" out the top of the well - in this case due to the rapid production of huge quantities of CO2 gas. Carbon dioxide (CO2) gas evolves very quickly when HCl comes into contact with limestone or dolomite. As the gas ventilates out the top of the well head it pushes the column of acid-water up and out right along with it, contaminating the surrounding field, trucks, people and anything else it touches. It makes a mess and is very difficult to clean up.

To prevent well-screen destruction and the casing from pitting, an inhibitor is necessary for any water well acid. Cotey Chemical uses a very effective inhibitor in its DRY ACID® SPECIAL. Table 1 depicts the relative corrosion rates of various metals commonly used in water well construction when treated with DRY ACID® SPECIAL, commercial muriatic acid, and commercial sulfuric acid. As illustrated, commercial muriatic acid dissolves most metals much faster, for instance with 1010 steel over four times faster, than Cotey's DRY ACID® SPECIAL.

METALS	DRY ACID® SPECIAL	MURIATIC ACID	SULFURIC ACID
1010 steel	1.0	4.2	2.6
Cast iron	1.0	3.2	3.2
Galvanized	1.0	rapid	63.0
Tin plate	1.0	23.0	81.0
304 Stainless	1.0	resistant	10.0
Copper	1.0	6.7	1.5
Brass	1.0	2.8	1.5
Bronze	1.0	7.0	4.0
Aluminum	1.0	5.3	0.6

Table 1 - Relative corrosion rates of various metals commonly used in water wells from DRY ACID® SPECIAL, muriatic acid and sulfuric acid.

DRY ACID® SPECIAL is a non-toxic, non-explosive and non-fuming granular product. It can be slowly and safely added to a water well without special training or special holding tanks and hoses. The slower reaction rate of DRY ACID®

SPECIAL reduces the possibility of a "blowout". Moreover, this slower reaction allows DRY ACID® SPECIAL to be pushed further into the water-bearing formation than HCl (muriatic acid), exposing it to more clogged surfaces. Also, because it's a granular product, no emergency exists if a spill does occur.

DRY ACID® SPECIAL also has a blend of polymers that are designed to suspend large amounts of calcium, magnesium, and iron minerals that are released as the acid dissolves deposits. This allows more material to be removed when pumping the spent chemicals to waste. The result is a better, more complete well rehabilitation.

LIQUID DESCALER is a potent combination of acids, surfactants, inhibitors and dispersants. LIQUID DESCALER dissolves mineral scales and then keeps them in solution to be flushed to waste. As mentioned above, one of the main chemicals used in LIQUID DESCALER is hydrochloric acid (HCl). HCl is a very potent acid capable of dissolving a variety of hard water scales in a minimum amount of time. While Cotey Chemical recognizes the value of HCl for down-hole applications in hard water areas, we are also aware of its strength. We have therefore added an excellent inhibitor to LIQUID DESCALER that protects the casing from pitting and the screen from being damaged.

Limestone is calcium carbonate. It is completely soluble in acid. Limestone aquifers precipitate hard water scales onto the well screen and the gravel pack, but cleaning the well screen and gravel pack is just part of the solution. Scale also builds up in and around the cracks and fissures in the formation through which water travels to arrive at the well. Scale builds faster around the areas where water flow velocities are higher. Therefore, the biggest restrictions are right at the place in the aquifer where the well has been drilled. Using chemicals to dissolve the limestone scale and also part of the limestone formation causes channels leading into the well bore to enlarge, allowing more water to enter and the flow to increase.

It isn't necessary to get deep penetration into the formation in order to get big increases in yield. Increasing the area just around the well bore is sufficient. It is similar to having a system with a great many one-inch pipes all connected to a one-inch common header. The capacity of the system is limited to the capacity of the header regardless of how many one-inch pipes are connected to it. To increase the capacity of the system, the size of the header must be increased. Essentially this is what is done when the area around the bore hole is opened with an acid treatment.

Iron & Manganese Scale

Ground water commonly contains iron in solution as ferric or ferrous salts. The ferric iron in solution in amounts greater than 0.01 occurs only at a pH less than 5.0. The ferrous ions allow the growth of iron-fixing bacteria such as Siderocapsa, Gallionella or Spirophyllum, Crenothrix and Leptothrix which oxidize dissolved iron and manganese. This causes precipitation of iron scale and/or slime and manganese hydroxide. The sulfate-reducing bacteria Desulfovibrio Disulfuricans also produce an iron slime. Manganese hydroxide or manganese carbonate is apparently produced by bacteria extracting manganese from plant life. Within the well, deposits of ferric oxide scale will be brownish to reddish brown whereas the hydrated ferrous oxide and the manganese oxide will be a black to very dark brown.

When well water containing ferrous iron is pumped to the surface, oxygen causes precipitation of ferric hydroxide by oxidation. This lowers the pH of the well water by removing the bicarbonate ion.

Manganese (Mn), as iron, also occurs in well water, but in two oxidized states. The typical reaction that occurs when water containing manganese is pumped to the surface is simple oxidation, forming manganese hydroxide. Manganese in ground water results from leaching soils, industrial wastes and bacterial contributions (amounts that exceed 0.30 ppm are harmful for human water supplies). Most ground water contains less than 0.20 ppm manganese, but in mining areas or areas that experience leaching by water which has been reduced, Mn may exceed 1.0 ppm.

Iron scale, calcium carbonate, manganese hydroxide and manganese carbonate scales are all soluble in mineral acids. Thus Cotey Chemical's DRY ACID® SPECIAL and LIQUID DESCALER are the recommended products. In wells that also have plugging from slime-forming bacteria, iron/manganese-oxidizing bacteria and sulfate-reducing bacteria, LIQUID DESCALER is recommended.

It is a good practice to monitor the pH of well water during the rehabilitation process. When acidizing a water well it is best to check the pH frequently. With pH levels at around 3.0 or above the product is losing strength and effectiveness. Begin by adding the recommended dose of chemical and then monitor the pH after each agitation. If the pH rises above 3.0 add more product. This process allows for a more accurate chemical treatment, which prevents over-treatment or under-treatment.

Bacteria, Slime & Related Biofouling

Cotey Chemical has developed a product with a blend of organic acid and special polymers called BIOCLEAN. BIOCLEAN is designed to be used with a strong mineral acid, like Cotey's DRY ACID® SPECIAL, to break down biological growths and dissolve mineral scales and then keep them in solution to be flushed to waste. BIOCLEAN has an effective anti-bacterial action that eliminates and /or inhibits the growth of many types of bacteria including slime-forming, sulfate-reducing and iron/manganese oxidizing bacteria. Once all of the biological growths are broken down and the minerals are dissolved, the dispersants in our BIOCLEAN "tie up" these particulates allowing them to be flushed from the well.

LIQUID DESCALER, as mentioned before, is a blend of polymers, surfactants, inhibitors, and acids: As such LIQUID DESCALER is similar to DRY ACID® SPECIAL and BIOCLEAN blended together into one product. The acids in LIQUID DESCALER work together to dissolve mineral deposits and biological fouling and then, like BIOCLEAN and DRY ACID® SPECIAL, hold the dissolved particulates in suspension to be pumped to waste.

Cotey has also developed the Cotey WELL CLEANING BRUSH designed to scrub the inside of well screen and act as a type of surge block. Our studies show that brushing the well, prior to chemical treatment, can remove interior screen deposits ensuring more uniform chemical access into the formation. The Cotey WELL CLEANING BRUSH and LIQUID DESCALER provide a staggering one-two punch that has proven successful in wells all over the world. Once the biological growths are broken down and the minerals are dissolved the well is ready for chlorination.

CHLORINATION

The accumulation of nuisance organisms such as fungi, algae, molds and various bacteria is a real problem in some areas. Generally speaking, this problem is best solved by preventive treatments rather than waiting until the well is plugged. Usually these organisms can be controlled if every

well is sterilized with some accepted method when the well is first completed and then treated periodically. Of prime importance is to construct the well to eliminate any surface contamination. If growths of nuisance organisms are present they can be cleaned up with suitable chemicals and then kept under control with periodic treatments.

All water wells, even if used for cropland irrigation, stock or industrial purposes, should be periodically sterilized. The common test for water pollution is for the presence of coliform bacteria which originates in the intestinal tracts of warm-blooded animals. Certainly, the presence of any coliform content in well water shows that other pathogens may also be present which could transmit dysentery, infectious hepatitis, burcellosis or salmonellosis to humans, or scours to swine and livestock. In fact, although caution is seldom exercised in supplying stock water, polluted water will produce a higher than average mortality rate in most animals, being particularly noticeable in slow weight gains and abortions in swine and cattle.

The standard method of treating water supplies for bacterial pollution is by chlorination. Chlorination is adding chlorine to water, essentially utilizing one of three forms of chlorine: chlorine gas, sodium hypochlorite (liquid bleach) or calcium hypochlorite.

Chlorine gas, when added to water, efficiently produces hypochlorous acid, the most effective disinfectant form of chlorine. However, chlorine gas is difficult to handle and is dangerous to humans and animals alike.

Sodium hypochlorite is a liquid product usually obtainable in 5-12 % available chlorine. The problem with sodium hypochlorite is that it has a very short "shelf life". This grocery store bleach product is made with 5.5% available chlorine and 94.5 % water. But, because it is relatively unstable, the bleach could quickly break down into mostly water if not used in a few months. For years it has been customary for drillers and household occupants to "disinfect" their water wells using household bleach. This method is almost totally ineffective because of the low level of chlorine concentration in the bleach and the small amount of bleach commonly used. As a typical example, let's take a 400-foot deep, 12-inch well with 300 feet of water. This well contains about 1765 gallons of water. In order to reach a chlorine concentration of + or - 200 ppm, 7 gallons of bleach is required. Unfortunately, treating this well with the "supermarket method" would probably consist of dumping one jug of laundry bleach down the hole rather than the 7 gallons actually needed to do the minimum job.

Calcium hypochlorite is a granular product usually available in 60-70% available chlorine. It is easier to handle and store than chlorine gas and is relatively stable in that it retains 90% of its chlorine content for 12 months after manufacturing. Cotey Chemical recommends using calcium hypochlorite found in Cotey's WEL-CHLOR to disinfect and sanitize new and old water wells and systems, remove nitrates, iron, sulfites (not sulfates), and manganese, and control algae, fungi and bacteria (including slime-forming, iron and sulfate-reducing bacteria).

When WEL-CHLOR is added to water the available chlorine produces hypochlorous acid (HOCl), a potent, fast-acting disinfectant. In fact hypochlorous acid is the workhorse in any chlorine application for sanitizing purposes. The amount of WEL-CHLOR required to create sufficient quantities of HOCl depends on:

- Bacterial numbers: If there are large numbers of aerobic or anaerobic bacteria in the water, a high chlorine dosage is required to ensure that all disease-causing organisms have been destroyed;

- pH: Hypochlorous Acid (HOCl) is the most effective form of chlorine for killing bacteria. It is most readily and safely developed in water

whose pH is between 6.0 and 7.0. Above 7.5 most of the chlorine dissociates to the hypochlorite ion, which is up to 250 times less effective a disinfectant than HOCl. Below a pH of 5.0 Chlorine gas (Cl) begins to form. Chlorine gas, a poor biocide, is a powerful irritant that can inflict damage to the eyes, nose, throat and lungs or may cause death by asphyxiation.

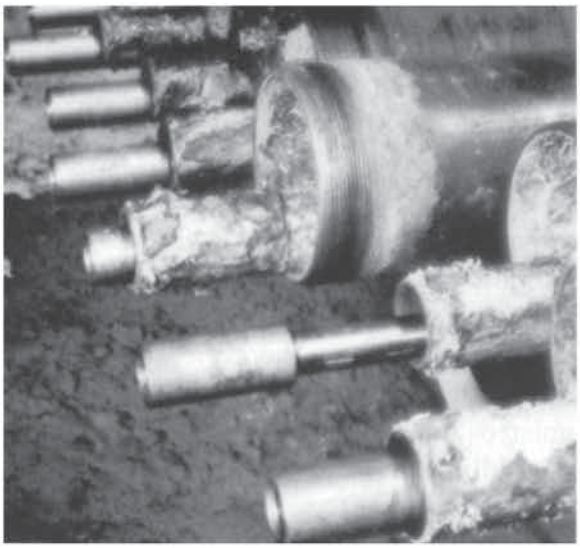
- Temperature: Affects disinfection speed (high temperature = fast disinfection);

- Turbidity: Chlorine is a surface-active agent. Any suspended particles (turbidity) will interfere with its disinfection ability. Therefore, enough WEL-CHLOR must be used to deal with these interfering elements and have enough left over to destroy all microorganisms in the well. It would be best to remove as many suspended particles as possible by pumping or developing the well for a period of time first and then add WEL-CHLOR.

For best results, premix a solution of water, WEL-CHLOR and Cotey's CHLORINE ENHANCER in a tank. CHLORINE ENHANCER is formulated to lower pH in a controlled fashion - unlike HCl (muriatic acid). Use CHLORINE ENHANCER to lower the pH of water in the tank to about 6.0. Add WEL-CHLOR and allow it to dissolve. The WEL-CHLOR will raise pH into the appropriate range for maximum HOCl production. Then introduce the solution into the well. Make sure to flood the well with at least three times the volume of water in the well.

Do not use muriatic (hydrochloric) acid to lower the pH of the water for chlorination, as this may produce dangerous gas.

Bacteria are usually present in the well, gravel pack and formation. However, chlorine is often just poured into the top of the well and circulated with the pump. The chlorine cannot kill



Pipes covered with bacterial growths

bacteria that it doesn't come into contact with. The procedure must ensure that the chlorine solution reaches into the formation and is evenly distributed throughout the system. Cotey recommends using a surge block, a jetting tool, or one of the Cotey WELL CLEANING BRUSHES (the bristles on Cotey's BRUSHES are so tightly placed that they act, not only as a scrubber on the inside of the well, but as a surge block giving the service provider a "plunger" effect that is not available with most handmade brushes) to do the job.

Chlorine is a great product to use for disinfecting water wells, an important step in well rehabilitation. However, Chlorine is not a complete rehabilitation chemical. It is very effective at oxidizing and killing free-swimming bacteria. But chlorine is ineffective if the bacterium in the well are encapsulated in slime, because it doesn't penetrate the slime barrier very efficiently.

Many water wells commonly contain bacterial slimes that plug water-bearing formations close to the well, gravel packs, and well screen and/or casing perforations. Such slimes are produced by iron and sulfate-reducing bacteria. The problem in these wells is not simply to kill the bacteria in

the well but to remove the slime that is harboring the bacteria.

Likewise, we know that 70-80 % of all wells in the United States have a buildup of mineral deposits. Mineral deposits not only block water flow, but also allow bacteria to attach to an otherwise clean surface. As mentioned previously, Cotey Chemical has several products designed to penetrate and dissolve mineral deposits and biological slime. Therefore, we recommend that all deposits, whether mineral or biological, are broken down using Cotey's products and pumped to waste prior to chlorinating.

OIL-LUBED PUMPS, ROOTS AND MORE

When water wells contain appreciable amounts of oil (probably from oil-lubricated pumps), organic slimes, tree roots and vegetative debris, or even carcasses of small animals, Cotey's WELGICIDE CLEANER should be used. WELGICIDE CLEANER is a highly alkaline chemical blend with detergency, sequestering, deflocculation, and buffering properties. As such, WELGICIDE CLEANER is one of the most versatile and effective chemical treatments offered by Cotey.

MAINTENANCE TREATMENT

Water well deterioration is somewhat analogous to dental disease. Once the disease destroys a certain amount of bone structure, the teeth become relatively useless. Similarly, once encrustations or silting reach a certain point in a water well, trying to extract water from the well becomes useless. Fortunately, water wells, like dental structure can be kept in optimum operating condition by preventative treatments; Cotey Chemical recommends such treatments for a well at least once a year. Needless to say, it is far easier to prevent incrustations and corrosion than it is to remove such deposits.

Studies show and our experience has confirmed that the typical water well will maintain its efficiency for the first 10-12 years of its life. (The national average is 12 years. Certainly this number is different depending on how much the well is used and how many nutrients/minerals are in the water).

After 12 years most wells require some type of rehabilitation. We believe that many wells begin to experience efficiency declines well before they are rehabilitated.

Our studies show that once a well has been drilled (or rehabilitated) it is more cost efficient to perform regular chemical maintenance than wait 12 years to perform a complete rehabilitation. Regular maintenance of the well will extend the life of the pump, reduce energy costs and increase the life of the well.

Regular well cleaning will keep the bacteria count down, mineral scales removed and generally keep the surfaces clean. It will also reduce the possibility of pulling the pump and performing full rehabilitation, or at least extend the amount of time before full rehabilitation is necessary.

Maintenance cleaning should be done on a regular basis. The cleaning can be performed from as often as once a month to once a year depending on how quickly the blockage builds.

Maintenance cleaning can be performed with the pump in the hole and usually with Cotey Chemical solutions of one to three percent.

CONCLUDING REMARKS

The flow loss in many wells is due simply to a lowering water table. In this case, nothing can be done except drill more wells or use less water.

However, for the majority of water wells, flow loss is due to biological and/or mineral deposits plugging the natural flow of water. At this point the problem is not how or why the water flow is obstructed but how best to remove the obstruction so maximum flow can be obtained. Some of the plugging will be removed by bailing, swabbing, surging, backwashing or pumping. Compressed air is also used to build up pressure and "air-lift" the well in an effort to remove all plugging. While mechanical agitation and air-lifting can certainly help loosen and/or remove some deposits, much of the flow will continue to be obstructed.

Chemicals that are effective in removing practically any type of water-pathway obstruction are available. In addition to mechanical agitation methods a properly designed chemical treatment will make it possible to do the job better and in less time.

The one-two punch of chemical and mechanical methods for treating a well provides a synergistic effect hard to match in today's industry.

Cotey Chemical has been designing products to unstop water wells for 60 years. Our products are packaged in small, easy-to-handle containers and are intended to be used by licensed well-drilling contractors, pump companies, and well service companies. We are trying to make your job easier, safer and more effective. The next time you have a water well that's not producing the water needed or desired, call Cotey Chemical Corporation. Satisfied clients located throughout the United States and in many foreign countries, attest to the claim of Mr. Cotey's motto, "BETTER WELLS WITH COTEY CHEMCIAL".

WELGICIDE CLEANER®

Use WELGICIDE CLEANER® to:

- remove bacterial slimes, iron oxides, iron bacteria, sulphur and sulfate-reducing bacteria.
- emulsify oil which has entered the well due to oil-lubricated pumps or accidental spillage.
- eliminate algae, vegetation or animals which have inadvertently fallen into the well.
- remove organic material from wells, plumbing, wash basins, sewer lines, and toilets.
- sterilize wells - the bactericidal effect remains potent for several weeks.

How to use WELGICIDE CLEANER®:

Use about 1/4-lb. of WELGICIDE CLEANER® per gallon of water inside the casing. (see table)

Pour in dry between casing and column pipe. Backwash well to mix and distribute chemical inside column pipe. Add the chemical carefully to the water as considerable heat will be generated when WELGICIDE CLEANER® is dissolved in water.

WELGICIDE CLEANER® should remain in the well for 24-36 hours and should be agitated every few hours. If a rig is over the hole agitate with a bailer, surge block or other tool. Dry ice can be used to agitate the chemical if rig or pump are not available.

Leave the chemical in the well for 24 to 36 hours.

Pump or bail the hole clean, and then test. Initial water after treatment contains spent chemicals and should be pumped to waste.

For additional chemical penetration and/or to remove "mud-cake", silt and clay also in the well use WELGICIDE CLEANER® with Cotey Chemical's MUD-NOX®.

Do not use WELGICIDE CLEANER® on aluminum, magnesium or galvanized pipes.

For best results:

- Brush the well with the COTEY WELL CLEANING BRUSH prior to chemical treatment. Brushing the well can remove interior screen deposits ensuring more uniform chemical access into the formation.

- Agitate the well with a tight-fitting surge block or other isolation tool (the Cotey WELL CLEANING BRUSH, for example). This dislodges material softened by the chemical treatment and pushes the chemical solution further into areas it may otherwise not be able to reach.

  (note: The combination of both chemical and mechanical energy is important for penetrating and removing the plugging material)

How to dispose of WELGICIDE CLEANER®:

Waste resulting from treatment with WELGICIDE CLEANER® is very alkaline, (has a high pH). Waste should therefore not be allowed to contaminate the domestic water supply. Although phosphates are often beneficial to crops, the attendant alkalinity is locally detrimental to the soil, thus waste should not be pumped to cultivated fields unless greatly diluted. Phosphates are also beneficial to fish, but detrimental to lakes and ponds in that they stimulate algae growth. It is therefore recommended that treatment waste be pumped to sewage, barrow ditches for natural evaporation, or to local pits for evaporation and consequent filling provided infiltration will not contaminate a local aquifer. In all cases waste should be thoroughly diluted. (Local, State and Federal regulations should be adhered to.)

CAUTION:

DO NOT MIX WELGICIDE CLEANER® WITH OTHER CHEMICALS!

When using this product, wear eye goggles or safety glasses.

WELGICIDE CLEANER® is a very strong alkali, thus do not take internally and keep from skin contact. Do not breath fine dust. Skin and eyes should be flushed with water if contact occurs and immediate medical attention should be secured. If ingested, drink large quantities of tea, coffee, or milk with raw eggs if available.

ADD PRODUCT SLOWLY TO THE WELL AS SOLUTION GENERATES CONSIDERABLE HEAT.

WELGICIDE CLEANER® is safe on all common metals in well equipment except for prolonged contact with aluminum or galvanized equipment.

WELGICIDE CLEANER® and all Cotey products are safe enough to use without pulling the pump.

WELGICIDE CLEANER® is packaged in 50-lbs. and 550-lbs. containers.

Diameter of Casing or hole (inches)	Gallons per foot of depth
3.0	0.37
3.5	0.50
4.0	0.65
4.5	0.83
5.0	1.02
5.5	1.23
6.0	1.47
7.0	2.00
8.0	2.61
9.0	3.31
10.0	4.08
11.0	4.94
12.0	5.88
13.0	6.90
14.0	8.00
15.0	9.18
16.0	10.00
17.0	11.79
18.0	13.22
19.0	14.73
20.0	16.32
22.0	19.75
24.0	23.50
26.0	27.58
28.0	31.99
30.0	36.72
32.0	41.78

DRY ACID®

Use DRY ACID® to:

- remove clays, shales, drilled "cuttings" and commercial drilling muds from water wells. Excellent for "gravel-slipping" and freeing stuck drill pipe.
- develop new wells to their maximum specific capacity by breaking down mud-cake produced during drilling.
- redevelop old wells producing in sand and gravel formations to their original flow or greater.

How to use DRY ACID®:

Use 1/2 to 3/4-lb. of DRY ACID® per gallon of water in large diameter wells, and 3/4 to 1-lb. of DRY ACID® per gallon of water is small diameter wells. (See table for calculation)

If a deep well turbine pump is in the hole, add about 1/4 the required amount of DRY ACID® at a time between the pump column and casing. Agitate by backwashing after each addition of acid. If a rig is over the hole, add the acid inside the casing and agitate with a bailer, surge block or other tool.

If well is gravel-packed, displace the acid solution back through the gravel by surging or adding water equal to about 3/4 the volume of water standing in the hole. In new wells displacement should occur soon after all the acid has been thoroughly mixed. In old wells allow the acid to stay in the casing for about an hour or more before adding the water. Water should be added slowly.

DRY ACID® should remain in the well for 24-36 hours and should be agitated every few hours. If a rig is over the hole agitate with a bailer, surge block or other tool. Dry ice can be used to agitate the chemical if rig or pump are not available.

Pump or bail the hole clean, and then test. Initial water after treatment contains spent chemicals and should be pumped to waste.

For additional chemical penetration use with Cotey Chemical's MUD-NOX®.

For best results agitate the solution in the well agressively with a tight-fitting surge block or the Cotey WELL CLEANING BRUSH.

How to dispose of DRY ACID®:

Treatment with DRY ACID® results in increased levels of sodium and bisulfate ions, depending on pH of the water. Thus, waste should not be pumped to cultivated fields as local reduced permeability and toxicity to plants may results. Waste should not be available to stock and should not be pumped to streams unless considerable dilution can be assured. Cotey therefore recommends that waste be pumped to sewage,

barrow ditches for natural evaporation, or to local pits for evaporation and consequent filling provided infiltration will not contaminate a local aquifer. In all cases waste should be thoroughly diluted. (Local, State and Federal regulations should be adhered to.)

CAUTION:

DO NOT MIX DRY ACID® WITH OTHER CHEMICALS!

DRY ACID® is primarily an acid. Avoid breathing the dust and flush with water in case of contact. Wash after handling and use with adequate ventilation. If swallowed drink large quantities of fluid such as tea, coffee, water or, better yet, milk with raw eggs if available. Secure medical aid as quickly as possible.

DRY ACID® is safe on plastics, rubber and metals commonly used in water well equipment. It will not harm the pump or well screen.

DRY ACID® and all Cotey products are safe enough to use without pulling thepump.

DRY ACID® is packaged in 10-lbs., 50-lbs., and 600-lbs. containers.

Diameter of Casing or hole (inches)	Gallons per foot of depth
3.0	0.37
3.5	0.50
4.0	0.65
4.5	0.83
5.0	1.02
5.5	1.23
6.0	1.47
7.0	2.00
8.0	2.61
9.0	3.31
10.0	4.08
11.0	4.94
12.0	5.88
13.0	6.90
14.0	8.00
15.0	9.18
16.0	10.00
17.0	11.79
18.0	13.22
19.0	14.73
20.0	16.32
22.0	19.75
24.0	23.50
26.0	27.58
28.0	31.99
30.0	36.72
32.0	41.78

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MUD-NOX®

Use MUD-NOX® to:

- "wet out" and disperse mud during bailing.
- add to drilling mud to reduce solids build-up, balling of drilled clay-shale, decrease friction, and aid in reducing solids suspension.
- slip gravel.
- decrease surface tension of water when using any chemical treatment.
- remove and emulsify oil in wells with oil-lubricated turbine pumps, or for shop degreasing.
- remove "mud-cake", silt and clay from water wells.

How to use MUD-NOX®:

Use approximately 1 gallon/200-400 gallons of water for mud problems, and slipping gravel.

Use approximately 1 gallon/400-600 gallons of water as a penetrant and emulsifier.

Use approximately 1 gallon/400-800 gallons of fluid as a drilling mud additive.

Add directly to water in system being treated. (See table on next page for calculation)

Agitate occasionally with the pump. If a rig is over the hole agitate with a bailer, surge block or other tool. Dry ice can be used to agitate the chemical if rig or pump are not available.

Pump or bail the hole clean, develop and test. Initial water after treatment contains spent chemicals and should be pumped to waste.

MUD-NOX® is a liquid blend of wetting agents, dispersants and emulsifiers. It is non-corrosive, non-contaminating and slowly biodegradable.

MUD-NOX® also works well when used as an additional wetting agent in conjunction with DRY ACID, WELGICIDE CLEANER or DRY ACID SPECIAL.

For best results brush the well with the Cotey WELL CLEANING BRUSH prior to chemical treatment. Brushing the well can remove interior screen deposits and ensures more uniform chemical access into the formation.

How to dispose of MUD-NOX®:

Waste resulting from treatment with MUD-NOX® should not be pumped where contamination of domestic water supplies could result. Surface activity agents disturb the water-holding ability of

soil, thus waste should not be pumped to cultivated fields. Stock and aquatic life are susceptible to concentrated amount of surface active agents, thus waste should be greatly diluted if left on surface. COTEY therefore recommends that waste be pumped to sewage, barrow ditches for natural biodegradation, or to local pits for biodegradation and consequent filling, provided infiltration will not contaminate a local aquifer. In all cases waste should be thoroughly diluted. (Local, State and Federal regulations should be adhered to.)

MUD-NOX® is a concentrated detergent, thus do not take internally. If swallowed, do not induce vomiting, call a physician. Keep out of eyes. For eyes, flush with fresh water and secure immediate medical attention. No hazard under normal use conditions.

MUD-NOX® is packaged in 1-gallon, 5-gallon and 55-gallon containers.

Diameter of Casing or hole (inches)	Gallons per foot of depth
3.0	0.37
3.5	0.50
4.0	0.65
4.5	0.83
5.0	1.02
5.5	1.23
6.0	1.47
7.0	2.00
8.0	2.61
9.0	3.31
10.0	4.08
11.0	4.94
12.0	5.88
13.0	6.90
14.0	8.00
15.0	9.18
16.0	10.00
17.0	11.79
18.0	13.22
19.0	14.73
20.0	16.32
22.0	19.75
24.0	23.50
26.0	27.58
28.0	31.99
30.0	36.72
32.0	41.78

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LIQUID DESCALER

Use LIQUID DESCALER to:

- remove biofilm produced by slime-forming bacteria, such as that produced by iron-oxidizing and sulfate-reducing bacteria.
- act as an excellent chelating agent (tie up) on iron sulfates and iron chlorides.
- dissolve carbonate, sulfate, magnesium and iron deposits (mineral deposits).
- keep dissolved solids in suspension more efficiently than other mineral acids improving well rinse-out.
- descale shop equipment corroded with iron scale.

How to use LIQUID DESCALER:

Descale equipment in water wells by using to 5 to 10 gallons per 100 gallons of water inside casing. (See table on next page for calculation)

LIQUID DESCALER should remain in the well for 24-36 hours and should be agitated every few hours. If a rig is over the hole agitate with a bailer, surge block or other tool. Dry ice can be used to agitate the chemical if rig or pump are not available.

Pump or bail the hole clean, develop and test. Initial water after treatment contains spent chemicals and should be pumped to waste.

For best results:

- Brush the well with the COTEY WELL CLEANING BRUSH prior to chemical treatment. Brushing the well can remove interior screen deposits ensuring more uniform chemical access into the formation.
- Agitate the well with a tight-fitting surge block or other isolation tool (the Cotey WELL CLEANING BRUSH, for example). This dislodges material softened by the chemical treatment and pushes the chemical solution further into areas it may otherwise not be able to reach.

  (note: The combination of both chemical and mechanical energy is important for penetrating and removing the plugging material)
- Monitor the pH during acid treatment. When acidizing a water well it is best to check the pH frequently. With pH levels above 3.0 the acid is losing strength and productivity. Check the pH after each agitation. If the pH rises above 3.0 add more acid. This process allows for a more accurate chemical treatment.

How to dispose of LIQUID DESCALER:

Waste resulting from treatment with LIQUID DESCALER contains a surface-active agent and, depending on quantity used and condition of the well treated, may be near neutral to very acidic. Cotey therefore recommends that waste be pumped to sewage, barrow ditches for natural evaporation and biodegradation, or to local pits for evaporation and consequent filling provided infiltration will not contaminate a local aquifer. In all cases waste should be thoroughly diluted. (Local, State and Federal regulations should be adhered to.)

CAUTION:

DO NOT MIX LIQUID DESCALER WITH OTHER CHEMICALS!

When using this product, wear eye goggles or safety glasses.

LIQUID DESCALER is a blend of liquid acids, polymers, surfactants and inhibitors. Thus, skin or eyes should be flushed with water if contact occurs and medical attention should be secured, particularly for the eyes. Avoid breathing spray or mist. If ingested drink large amounts of liquid such as tea, coffee, water or milk and raw eggs if available. Secure immediate medical aid.

LIQUID DESCALER is safe on all common metals in well equipment except for prolonged contact with aluminum or galvanized equipment. Use DRY ACID® SPECIAL and BIOCLEAN for descaling aluminum or galvanized equipment.

LIQUID DESCALER is packaged in 1-gallon, 5-gallon and 55-gallon containers.

Diameter of Casing or hole (inches)	Gallons per foot of depth
3.0	0.37
3.5	0.50
4.0	0.65
4.5	0.83
5.0	1.02
5.5	1.23
6.0	1.47
7.0	2.00
8.0	2.61
9.0	3.31
10.0	4.08
11.0	4.94
12.0	5.88
13.0	6.90
14.0	8.00
15.0	9.18
16.0	10.00
17.0	11.79
18.0	13.22
19.0	14.73
20.0	16.32
22.0	19.75
24.0	23.50
26.0	27.58
28.0	31.99
30.0	36.72
32.0	41.78

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WEL-CHLOR
(Calcium Hypochlorite 65% active ingredients)

Use WEL-CHLOR to:

- Disinfect and sanitize new and old water wells and systems
- Remove nitrates, iron, sulfites (not sulfates), and manganese
- Control algae, fungi and bacteria (including slime-forming, iron, and sulfate-reducing bacteria)

How to use WEL-CHLOR:

To disinfect old and new wells use about 4 ounces of WEL-CHLOR per 100 gallons of water in the well. (See tables on next page for calculations)

Pre-mix WEL-CHLOR with water in a container outside the well and allow it to dissolve. Add the solution through the water-level access hole or other opening between casing and column pipe, or through discharge.

Agitate the solution in the well every few hours for eight hours. This helps ensure even mixing, helps treat more of the well and pushes the chemical further into the formation.

Pump or bail the hole clean. Then test for bacteria. After treatment, the initial water contains residual chemical and should be thoroughly diluted and pumped to waste.

For best results:

- Clean the well both mechanically and chemically prior to WEL-CHLOR treatment. Brush the well with the COTEY WELL CLEANING BRUSH. This allows WEL-CHLOR to have more uniform access into the information.
- Premix a solution of water and WEL-CHLOR in a water tank by using the following guidelines:
  Lower the pH of the water in the tank to about 6.0 by adding 30 ounces of Cotey's Chlorine Enhancer to 500 gallons (1.89 kl) of water. Add 20 ounces of WEL-CHLOR. This will yield an approximate solution of 200 ppm available chlorine. The pH will also increase into an optimal range for disinfecting and sanitizing.
- Premix an amount of water and WEL-CHLOR solution that would approximate three times the volume of water in the well. It may be necessary to make several smaller batches.
- Add this solution to the well and agitate every few hours for eight hours. Then pump or bail the hole clean.

To disinfect equipment, use about one ounce of WEL-CHLOR and 1 1/2 ounces Chlorine Enhancer per 25 gallons of water. Allow the equipment to soak in the solution for one hour. Thoroughly dilute waste and dispose of properly.

Note: Always disinfect equipment before moving to another well to prevent accidental contamination of other wells.

How to dispose of WEL-CHLOR:

Waste testing < 50 ppm of residual chlorine presents no hazard to crops whereas the susceptibility of fish ranges from 0.1 to 5.0 ppm, depending on pH, dissolved oxygen, temperature and synergism/antagonism of other pollutants. Well waste, after treatment, should therefore not be pumped into streams and, if pumped on fields, should be checked for chlorine concentration or thoroughly diluted. Cotey Chemical recommends that waste be pumped to sewage, barrow ditches for natural evaporation, or to local pits for evaporation and consequent filling, provided infiltration will not contaminate a local aquifer. In all cases waste should be thoroughly diluted. (Local, State and Federal regulations should be adhered to.)

CAUTION:

DO NOT MIX WEL-CHLOR WITH OTHER CHEMICALS EXCEPT CHLORINE ENHANCER

When using WEL-CHLOR, wear eye goggles or safety glasses.

WEL-CHLOR is a strong oxidizer, thus skin or eyes should be flushed with water if contact occurs and medical attention should be secured, particularly for the eyes. Avoid breathing spray or mist. If ingested, drink large amounts of liquid such as water. Seek immediate medical aid. Do not induce vomiting!

Contact with materials other than water may cause fire or explosion. Separate from other COTEY CHEMICAL PRODUCTS.

Do not mix with other chemicals. Do not change containers.

WEL-CHLOR is packaged in 10-lbs. and 50-lbs. containers.

Diameter of Casing or hole (inches)	Gallons per foot of depth
3.0	0.37
3.5	0.50
4.0	0.65
4.5	0.83
5.0	1.02
5.5	1.23
6.0	1.47
7.0	2.00
8.0	2.61
9.0	3.31
10.0	4.08
11.0	4.94
12.0	5.88
13.0	6.90
14.0	8.00
15.0	9.18
16.0	10.00
17.0	11.79
18.0	13.22
19.0	14.73
20.0	16.32
22.0	19.75
24.0	23.50
26.0	27.58
28.0	31.99
30.0	36.72
32.0	41.78

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WEL-CHLOR

Water (gallons)	Granular Calcium Hypochlorite (65% available chlorine)	Sodium Hypochlorite (household bleach) (5% available chlorine)	Sodium Hypochlorite (10% available chlorine)	CHLORINE ENHANCER
1	0.04 ozs.	0.13 fluid ounces	0.25 fluid ounces	0.06 ozs
125	5 ozs.	½ gallon	1 quart	7.5 ozs
250	10 ozs.	1 gallon	½ gallon	15 ozs
500	20 ozs. (1 lb 4 ozs.)	2 gallons	1 gallon	30 ozs (1 lb 14 ozs)
1000	40 ozs. (2 lbs 8 ozs.)	4 gallons	2 gallons	60 ozs (3 lbs 12 ozs)

CHLORINE ENHANCER

Use CHLORINE ENHANCER to:

adjust the pH of water so chlorine becomes 100 times more effective

How to use CHLORINE ENHANCER:

- Pre-mix the appropriate amount of Cotey Chemical's WEL-CHLOR and water in an above-ground tank to yield a 200 ppm solution. Stir until dissolved.
- Add the required amount of CHLORINE ENHANCER (see the chart below) to the tank solution and stir until well-blended.
- Pour the pre-mixed solution into the well.
- Leave the solution in the well for 5-7 hours. If possible circulate the solution in the well with the pump every few hours.
- After treating, the initial water contains spent chemical and should be pumped to waste. Adhere to local, state and federal regulations. Once the well is clean, test for bacteria.

Studies have shown that to successfully chlorinate a water well use a 200 part-per-million chlorine concentration. In order to achieve a 200 ppm concentration and to determine how much CHLORINE ENHANCER is needed, use the following table. It's very important to follow this chart because too much CHLORINE ENHANCER could lower pH values into a range that may evolve harmful gases.

Water (gallons)	WEL-CHLOR Granular Calcium Hypochlorite (65% available chlorine)	Sodium Hypochlorite (household bleach) (5% available chlorine)	Sodium Hypochlorite (10% available chlorine)	CHLORINE ENHANCER
1	0.04 ozs.	0.13 fluid ounces	0.25 fluid ounces	0.06 ozs
125	5 ozs.	½ gallon	1 quart	7.5 ozs
250	10 ozs.	1 gallon	½ gallon	15 ozs
500	20 ozs. (1 lb 4 ozs.)	2 gallons	1 gallon	30 ozs (1 lb 14 ozs)
1000	40 ozs. (2 lbs 8 ozs.)	4 gallons	2 gallons	60 ozs (3 lbs 12 ozs)

Note: One lid full of CHLORINE ENHANCER (from the 10-lb container) is about 7 ounces.

For Best Results:

In an above-ground tank, pre-mix a solution of WEL-CHLOR, CHLORINE ENHANCER and water that would approximate three times the volume of water in the well. Add this to the well. If the above-ground tank is not large enough it may be necessary to make several smaller batches.

Why this chemical is important:

Sodium or Calcium Hypochlorite are the most common sources of chlorine used in our industry today. When either are added to water both hypochlorous acid and hypochlorite ion are produced. Hypochlorous acid (HOCl) is much more effective against bacteria - over 100 times more -than the hypochlorite ion. But, the amount of HOCl produced depends on the pH of the water. Above pH 7.5 very little chlorine occurs as helpful hypochlorous acid, but rather as ineffective hypochlorite ion. Therefore, the pH of the water should be kept between 6.0 and 7.5 to ensure good results. If the water gets below 6.0 chlorine gas may be formed which is dangerous for workers.

CHLORINE ENHANCER is specially formulated to lower the pH of water so HOCl may be produced. By carefully following the use instructions you will receive maximum benefit from your chlorine application. Whether using calcium or sodium hypochlorite to chlorinate the well, not as much is needed, thus your equipment is safer, you are safer and you save money.

How to dispose of Cotey's CHLORINE ENHANCER:

Waste testing showed that less than 50 ppm residual chlorine presents no hazard to crops whereas fish are susceptible in ranges from 0.1 to 5.0 ppm, depending on pH, dissoved oxygen, temperature and synergism/antagonism of other pollutants. Therefore, waste should not be pumped into streams and should be thoroughly dilluted if pumped onto fields. Cotey Chemical recommends that waste be pumped to sewage or barrow ditches for natural evaporation, or to local pits for evaporation and then filling provided filtration won't contaminate a local aquifer. In all cases waste should be thoroughly diluted. Adhere to local, state and federal regualations.

Caution:

Corrosive. Keep out of reach of children. May be fatal if swallowed. Do not breathe dust. Use splash goggles and rubber gloves when handling this material. Avoid contact with eyes. May produce chemical burns. Do not get in eyes, on skin or on clothing. Use in a well ventilated area. Always use proper dosage because dangerous gas could be produced if pH of solution is too low. Never add CHLORINE ENHANCER to concentrated chlorine (concentrated calcium or sodium hypochlorite).

Proper U.S. DOT Shipping Name:
Not regulated by the DOT.

Diameter of Casing or hole (inches)	Gallons per foot of depth
3.0	0.37
3.5	0.50
4.0	0.65
4.5	0.83
5.0	1.02
5.5	1.23
6.0	1.47
7.0	2.00
8.0	2.61
9.0	3.31
10.0	4.08
11.0	4.94
12.0	5.88
13.0	6.90
14.0	8.00
15.0	9.18
16.0	10.00
17.0	11.79
18.0	13.22
19.0	14.73
20.0	16.32
22.0	19.75
24.0	23.50
26.0	27.58
28.0	31.99
30.0	36.72
32.0	41.78

NSF
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DRY ACID® SPECIAL

Use DRY ACID® SPECIAL to:

- dissolve limestone, hard-water scale, rust and corrosion deposits.
- keep dissolved solids in suspension more efficiently than other mineral acids improving well rinse-out.
- develop new wells producing from limestone or calcareous sand and gravel formations.
- redevelop old wells that have hard-water scale, rust or corrosion deposits plugging the perforations, screen or formation.

How to use DRY ACID® SPECIAL:

Use 3/4 to 1 lb. of DRY ACID® SPECIAL per gallon of water in the well. (See table)

If you are acidizing the formation and the well is gravel-packed, displace the acid back through the gravel wall by surging or adding water equal to about 3/4 the volume of water standing in the hole. In new wells the displacement should occur soon after all the acid has been added and thoroughly mixed. In old wells allow the acid to stay in the casing for a few hours before adding the water. Water should be added slowly.

Note: A five percent acid concentration is considered an absolute minimum for effective cleaning.

DRY ACID® SPECIAL should remain in the well for 24-36 hours and should be agitated every few hours. If a rig is over the hole agitate with a bailer, surge block or other tool. Dry ice can be used to agitate the chemical if rig or pump are not available.

Pump or bail the hole clean, develop and test. Initial water after treatment contains spent chemicals and should be pumped to waste.

For best results:

- Brush the well with the COTEY WELL CLEANING BRUSH prior to chemical treatment. Brushing the well can remove interior screen deposits ensuring more uniform chemical access into the formation.

- Agitate the well with a tight-fitting surge block or other isolation tool (the Cotey WELL CLEANING BRUSH, for example). This dislodges material softened by the chemical treatment and pushes the chemical solution further into areas it may otherwise not be able to reach.

  (note: The combination of both chemical and mechanical energy is important for penetrating and removing the plugging material)

- Monitor the pH during acid treatment. When acidizing a water well it is best to check the pH frequently. With pH levels above 3.0 the acid is losing strength and productivity. Check the pH after each agitation. If the pH rises above 3.0 add more acid. This process allows for a more accurate chemical treatment.

How to dispose of DRY ACID® SPECIAL:

Waste from DRY ACID® SPECIAL treatment should not be pumped to cultivated fields nor made available to livestock. Depending on quantity used and condition of the well treated, waste may be near neutral, to very acidic. Cotey therefore recommends that waste be pumped to sewage, barrow ditches for natural evaporation, or to local pits for evaporation and consequent filling provided infiltration will not contaminate a local aquifer. In all cases waste should be thoroughly diluted. (Local, State and Federal regulations should be adhered to.)

CAUTION:

DO NOT MIX DRY ACID® SPECIAL WITH OTHER CHEMICALS!

DRY ACID® SPECIAL is primarily an acid. Avoid breathing the dust and flush with water in case of contact. Wash after handling and use with adequate ventilation. For ingestion of sulfamic acid drink large amounts of water, tea, coffee or milk with raw eggs, and secure immediate medical attention.

Store DRY ACID® SPECIAL away from chlorine. Do not add chlorine or liquid bleach to wells treated with DRY ACID® SPECIAL until the well has been flushed to waste. Chlorides added to sulfamic acid may form nitrogen trichloride (NCl_3), an explosive.

DRY ACID® SPECIAL is fully inhibited and is safe on plastics, rubber and most metals commonly used in water well equipment. It will not harm the pump or well screen. There are no acid fumes, no hazardous carboys, low handling costs, yet there is a rapid decomposition of carbonate scales.

Dry Acid® Special is packaged in 10-lbs., 50-lbs. and 600-lbs. containers.

Diameter of Casing or hole (inches)	Gallons per foot of depth
3.0	0.37
3.5	0.50
4.0	0.65
4.5	0.83
5.0	1.02
5.5	1.23
6.0	1.47
7.0	2.00
8.0	2.61
9.0	3.31
10.0	4.08
11.0	4.94
12.0	5.88
13.0	6.90
14.0	8.00
15.0	9.18
16.0	10.00
17.0	11.79
18.0	13.22
19.0	14.73
20.0	16.32
22.0	19.75
24.0	23.50
26.0	27.58
28.0	31.99
30.0	36.72
32.0	41.78

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BIOCLEAN

(use with Cotey Chemicals DRY ACID® SPECIAL or other strong mineral acid)

Use BIOCLEAN to:

- remove biofilm produced by slime-forming bacteria, such as that produced by iron-oxidizing and sulfate-reducing bacteria,
- improve rinse-out of well treated with mineral acid by dispersing carbonate, sulfate, magnesium and iron deposits.

How to use BIOCLEAN as a mineral acid enhancer:

Use 1 gallon (3.8 liters) of BIOCLEAN per 40 gallons (152 liters) of water in the well (see table). For heavy biofouling use 2 gallons per 40 gallons of water.

Brush and bail the well. Prior to chemical treatment, mechanical cleaning of the well can remove interior screen deposits, which ensures more uniform access of the chemical into the formation. Common mechanical cleaning tools include brushing, swabbing and jetting. Then bail the debris from the bottom of the well.

Pour BIOCLEAN directly into the well. BIOCLEAN can also be premixed in a tank and introduced into the well from the top or injected into the screen area.

Agitate the solution in the well every two to four hours for 24-36 hours. If a rig is over the hole, agitate with a bailer, surge-block or other tool. Dry ice can be used to agitate the chemical if rig or pump is not available.

Pump or bail the hole clean, develop and test. Continue pumping until pH of water is within 0.5 pH units of the original value before treatment. Initial water after treatment contains spent chemical and should be pumped to waste. Repeat above steps as necessary to achieve optimum production of the well.

For best results:

- Brush the well with the COTEY WELL CLEANING BRUSH prior to chemical treatment. Brushing the well can remove interior screen deposits ensuring more uniform chemical access into the formation.
- Agitate the well with a tight-fitting surge block or other isolation tool (the Cotey WELL CLEANING BRUSH, for example). This dislodges material softened by the chemical treatment and pushes the chemical solution further into areas it may otherwise not be able to reach.

  (note: The combination of both chemical and mechanical energy is important for penetrating and removing the plugging material)

- Monitor the pH during acid treatment. When acidizing a water well it is best to check the pH frequently. With pH levels above 3.0 the acid is losing strength and productivity. Check the pH after each agitation. If the pH rises above 3.0 add more acid. This process allows for a more accurate chemical treatment.

How to dispose of BIOCLEAN:

> BIOCLEAN is rapidly biodegradable. Waste from BIOCLEAN treatment should not be pumped to cultivated fields nor made available to livestock. Depending on quantity used and condition of the well treated, waste may be near neutral to very acidic. COTEY CHEMICAL therefore recommends that waste be pumped to holding tank or pit for neutralization and disposal. (Local, State and Federal regulations should be adhered to.)

BIOCLEAN is safe to use with other mineral acids such as Cotey Chemical's DRY ACID® SPECIAL. It is fully inhibited and safe to use on plastics, rubber and metals commonly used in water well equipment.

BIOCLEAN is packaged in 1-gallon, 5-gallon and 55-gallon containers.

Diameter of Casing or hole (inches)	Gallons per foot of depth
3.0	0.37
3.5	0.50
4.0	0.65
4.5	0.83
5.0	1.02
5.5	1.23
6.0	1.47
7.0	2.00
8.0	2.61
9.0	3.31
10.0	4.08
11.0	4.94
12.0	5.88
13.0	6.90
14.0	8.00
15.0	9.18
16.0	10.00
17.0	11.79
18.0	13.22
19.0	14.73
20.0	16.32
22.0	19.75
24.0	23.50
26.0	27.58
28.0	31.99
30.0	36.72
32.0	41.78

NSF

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COTEY WELL CLEANING BRUSH

(Patent No. US7,121,336 B2)

• All purpose brush for cleaning all types of casing and screen including PVC!

• Unique design - agitates, surges and scrubs simultaneously!

• Self cleaning - scale particles flush out of the brush!

• Versatile! Attaches to cable or pipe.

• Floating brush design ensures free movement, which virtually eliminates binding or "hanging up" inside the casing!

• Interchangeable brush design allows you to select the brush size to match the casing to be brushed!

• Durable! Will not wear out as quickly and holds its shape better than conventional steel-bristled brushes. Heavy-duty bristles are made of the highest quality polypropylene.

For best results use with Cotey's well cleaning chemicals

Special order
brush sizes available

J200 Model:

- Designed to use four interchangeable brushes to clean 4, 4 1/2, 5, 6 and 8-inch casing
- 2-inch pipe threaded bail with 5/8-inch shackle allows it to be run on cable
- 2-inch pipe thread allows it to be run on 2-inch pipe
- 48 inches long allows it to be shipped on a typical pallet
- Weighs 45 pounds

J400 Model:

- Designed to use two interchangeable brushes to clean 8, 10, 12, 14, 16, 18, 20, 22 and 24-inch casing.
- 4-inch pipe thread bail with 3/4-inch shackle allows it to be run on cable
- 4-inch pipe thread allows it to be run on 4-inch pipe
- 48 inches long allows it to be shipped on a typical pallet
- Weighs 165 pounds

Special order brush size available

Made in the USA

QUICK REFERENCE TABLE

PROBLEM	RECOMMENDED PRODUCT	TREATMENT TIME
Algae	Welgicide Cleaner	24 hrs
Animals in well	Welgicide Cleaner	24 hrs
Bacterial "slime"		
-Hard water areas-well with galvanized parts	Dry Acid Special & BioClean	24 hrs
-Hard water areas-well without galvanized parts	Liquid Descaler	24 hrs
-Soft water areas	Welgicide Cleaner	24 hrs
-Soft water areas-well with galvanized parts	Dry Acid Special & BioClean	24 hrs
Calcium carbonate scale (calcite)		
-Well with galvanized parts	Dry Acid Special	24 hrs
-Well without galvanized parts	Liquid Descaler	24 hrs
Calcium sulfate scale (gypsum)	Liquid Descaler	48-72 hrs
Coliform bacteria-Free swimming in water	Wel-Chlor & Chlorine Enhancer	8-12 hrs
-Encapsulated in slime-with galvanized parts	Dry Acid Special & BioClean	24 hrs
-Encapsulated in slime-without galvanized parts	Welgicide Cleaner	24 hrs
Drilling mud	Dry Acid or Mud-Nox	24 hrs
Iron bacteria-Free swimming in water	Wel-Chlor & Chlorine Enhancer	12 hrs
-Encapsulated in slime-with galvanized parts	Dry Acid Special & BioClean	24 hrs
-Encapsulated in slime-without galvanized parts	Liquid Descaler	24 hrs
Iron scale (iron oxide)		
-Well with galvanized parts	Dry Acid Special	30 hrs
-Well without galvanized parts	Liquid Descaler	30 hrs
Mud-cake	Dry Acid or Mud-Nox	24 hrs
Oil film (drip oil from oil-lubricated turbine pump)	Mud-Nox	12 hrs
Oil slime (bacteria "feeding off" drip oil)	Welgicide Cleaner	24 hrs
Old inactive well		
Hard water area-without bacterial slime-with galvanized parts	Dry Acid Special	24 hrs
Hard water area-with bacterial slime-without galvanized parts	Liquid Descaler	24 hrs
Hard water area-with bacterial slime-with galvanized parts	Dry Acid Special & BioClean	24 hrs
Soft water area-with bacterial slime-without galvanized parts	Welgicide Cleaner	24 hrs
Rust & Corrosion deposits		
-well with galvanized parts	Dry Acid Special	24 hrs
-well without galvanized parts	Liquid Descaler	24 hrs
Silting of well	Dry Acid	24 hrs
Sterilizing well	Wel-Chlor & Chlorine Enhancer	8-12 hrs
Sulfate-reducing bacteria		
-well with galvanized parts	Dry Acid Special & BioClean	24 hrs
-well without galvanized parts	Liquid Descaler	24 hrs
Vegetation in well (i.e. small "hairy" tree roots)	Welgicide Cleaner	24-36 hrs

4410 MLK Jr. Blvd.
P.O. Box 2039
Lubbock, Texas 79408
800.457.2096
806.747.2096
806.747.7138 fax
www.coteychemical.com