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**WELLPOINTS FOR
HYDROCARBON RECOVERY**

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ABSTRACT

The presence of hydrocarbons in the groundwater as a result of petroleum spills or leaking tanks at service stations, fuel depots, and refineries is an ongoing problem. The use of wellpoint dewatering systems for hydrocarbon recovery and subsequent treatment is a proven, cost effective option. This paper provides an overview of the history of early wellpoint development, a discussion of basic design and installation methods for wellpoint systems, and the advantages of wellpoint dewatering in the recovery of hydrocarbon-contaminated groundwater.

HISTORY OF WELLPOINTS

The development of the first practical wellpoint for construction dewatering has its roots in the sewer contracting business. At the end of the 19th century, sewer excavating was a manual process. Conveyor carriages for the hoisting of filled excavating buckets were run from end to end of the trench on elevated tracks supported on moveable trestles. These constituted an expensive part of the trenching apparatus and, as they spanned the trench at short intervals, they formed obstructions which interfered with the work of the excavating crew in the trench. Thomas Moore, the founder of Moretrench American Corporation, designed and built an excavating machine that would overcome these problems. Moore rented this machine to a sewer contractor in Hackensack, NJ in 1924.

Problems on the project soon became apparent. Within a few minutes of the start of digging, the disturbed soil in the trench became 'quick,' resembling what was known in the local construction industry as "bull's liver," a soft, unstable mass that quakes like jelly (or liver) when subject to vibration or shock. Trench excavation was reduced to a few feet a day. Lowering the groundwater to dry the unstable soils was necessary. Although driven wellpoints had been used in the United States for construction dewatering since very early 1900s, they had typically been used in medium, clean, uniform sands. Moore designed, built and installed a full-sized wellpoint system at Hackensack that could dewater the excavation without clogging up, allowing the contractor to vastly increase production and enabling him to complete the project and pay rent overdue on the machine.

Over the years, Moore perfected the use of wellpoints for construction dewatering applications and through the 1930s, 40s, 50s, 60s and 70s Moretrench was the largest manufacturer of wellpoint equipment in the world. During that time installations were made at thousands of excavations in a wide variety of soil types and conditions.

WELLPOINT DESIGN AND INSTALLATION

A wellpoint system consists of a series of small diameter wells connected to a common header pipe. The header pipe is evacuated by a combination pumping unit which is a centrifugal pump continuously primed by a vacuum pump. Atmospheric pressure forces water through the ground to the wellpoint screen, up the riser and through the header to the pump. Any air entering the system is separated in a float chamber and passed to the vacuum pump. The water passes into the centrifugal pump to discharge or treatment.

It's not the intent of this paper to provide all of the information necessary to properly design a wellpoint system. The reader should reference Powers, J.P. et al (2007). *Construction Dewatering and Groundwater Control* 3rd ed. John Wiley & Sons, Inc., Hoboken, NJ.

The use of wellpoints is limited to sites in which the groundwater table is relatively shallow. Wellpoint systems are limited by the suction lift generated from the vacuum in the header. The maximum theoretical lift, at sea level is approximately 32 feet; however, due to vacuum pump limitations, piping and friction loss, etc. the depth to product and/or groundwater should not exceed 15 feet. The depth is calculated from the centerline of the vacuum pump. Under special circumstance with some additional consideration and equipment design a the suction lift can be extended to 20 feet or so. One foot of suction lift is lost for approximately every 1,000 in elevation gain.

The proper design of the wellpoint equipment is essential to the success or failure of a system to recover hydrocarbons. Grain size curves developed from actual samples collected from the formation are the first step. From the grain size curves the proper slot size for the well screen and gradation of the filter pack surrounding the well can be determined.

Installation methods have been developed to suit the varied conditions under which wellpoints function. When designing a system of wellpoints for hydrocarbon recovery careful consideration of the installation method must be made to ensure that the well communicates with the formation in the best possible way. The following is a list of the more common installation methods.

- Self-jetting wellpoints are suitable for installation in sands and gravels, silts, and soft to firm clays. In stratified soils a jetting chain is recommended. This simple device opens a larger hole, six inches being common, in clay and silt layers, providing space for filter sand to induce vertical drainage and prevent clogging of the screen.
- A holepuncher can be used to penetrate coarse gravel and cobbles, boulders, and very permeable soils that are subject to “loss of boil,” the dissipation of the jetting stream into the formation. After reaching the desired depth the head is removed and the wellpoint installed before the holepuncher is extracted.
- The holepuncher and casing is effective in clays and hardpans where the holepuncher acting as a drop hammer can drive the casing. The holepuncher and casing are also advisable when it is desired to provide a 10-inch or larger hole around the wellpoint, to provide filter sand for vertical drainage in stratified soils.

Where ground is difficult to penetrate various drilling methods are employed to facilitate wellpoint installation. These include continuous flight augers, hollow stem augers, and rotary drilling with fluid. With any of the methods, washing of the drilled hole before placement of filter sand improves the yield of the wellpoint.

WELLPOINTS FOR HYDROCARBON RECOVERY

The first documented use of wellpoints for hydrocarbon recovery dates to the early 1950s. Gasoline coming up out of the ground along New Jersey Turnpike extension was causing cars to skid. Moretrench installed a wellpoint system to collect the gasoline-contaminated groundwater. The treatment of the day included pumping the water into an open field and igniting it. Since that time, the use of wellpoint systems to recover hydrocarbons has been refined and modified to suit environmental regulations and provide preferential pumping of the hydrocarbon. Wellpoint pumps have also been modified so that the oil/water mixture is not emulsified during the pumping process. Treatment systems have also been developed that remove the free phase product as well as any dissolved contaminants that maybe present in the water.

Advantages

Wellpoints offer number of advantages for hydrocarbon recovery:

- The number of wellpoints operated off of the vacuum pump is nearly unlimited. Systems have been built with hundreds of wellpoints and hundreds of feet of header pipe.
- The wellpoints and be installed on a grid pattern, straight line or any convenient pattern.
- They are less expensive to install and more efficient than conventional recovery wells, which allow for more “pickup” points at a site.
- Less drawdown is required to affect a radius of influence around each pickup point. Limiting the drawdown means that the product/water moves through more of the contaminated zone which acts to flush the soil. Systems have been constructed that include a device which provides

preferential pumping of the free phase product. The desired drawdown is set at each wellpoint. When a large drawdown is created, much of the free phase product gets hung up in the soil pores.

- Wellpoints require only one above-ground pumping station. This pumping system is less maintenance intensive than an individual pumps at each well.
- Vacuum created by the system helps draw the fluid to the wellpoint. It is important to note that a drawdown will be created in the wellpoint at the same time so that upwelling of the fluid to the well will not occur.
- Hydraulic control of the product plume can also be achieved thereby preventing offsite migration or movement of the product into a water body
- The wellpoint pump can also operate with many wells and well types. This allows monitoring wells or old recovery wells to be utilized as extraction points. It is also possible to install any type of conventional skimming device into the system.
- The wellpoint system can be used for many different remediation approaches. For example, every other wellpoint can be pumped out while steam or surfactants are injected into the others. Every other wellpoint can be turned into a vapor extraction point with every other wellpoint used as a sparge point. The infrastructure is in place for various remedial approaches.
- Wellpoints offer predictable results, achievable through many years of practical experience and research.

Combining all of the above provides for recovery at a faster rate than conventional methods thus providing substantial cost savings. Systems have been installed and constructed to recover gasoline, hydraulic oils, diesel fuel, home heating oil, and fuel oil #6 at industrial sites, chemical plants and homeowner sites throughout the east coast.

HYDROCARBON TREATMENT METHODS

Customized Treatment Systems

Customized treatment systems for pumped water are configured specifically for the contaminant(s) encountered. Treatment elements may include:

- Equalization
- Dissolved air flotation
- Oil/water separation
- Coagulation/flocculation
- Settling and clarification
- Chemical oxidation
- pH neutralization
- Air stripping
- Filtration
- Liquid and vapor carbon systems
- Thermal/catalytic oxidation