

# Well Construction & Refurbishment

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## *Water - the blue gold*



The world's oldest cultures developed close to rivers and alluvial plains. The fundamental nature of this dependence can also be seen in Persian language. There, the first word in the dictionary is "ab", which means "water". Derived from this is the word "aba dan", which signifies "civilized".

Thus, water in its true sense of the word represents civilization. At the same time one may argue that civilization cannot exist where there is no water.

Even so, 1.7 billion people are still said to live without a sufficient supply of safe drinking water today. Furthermore, the price of water rarely ever mirrors its true value but mostly represents a political price. In this respect one can be glad to be living in Germany or another central European country, where problems with the drinking water supply are mostly unknown.

However, factors like increased industrialization, the spreading of settlements, concentrated agriculture and the rising use of biomass, increase the pressure on our resources of drinking water.

For years these factors, in combination with complex mechanisms of control and analysis, have placed great demands on H. Anger's Söhne as a drilling company.



## Well construction over 140 years

As long as there are no watercourses close by, the building of a well has always been the only possible way of gaining access to clean drinking water. Today this work is carried out after thorough planning and by using the most modern techniques for each individual well.

This process is composed of three main components.

First of all the well is constructed using a drilling rig. The drill's diameter decreases in a telescoping manner, depending on the predominant geological formations and

their respective depth at the well site (see illustration).

In a second production step the borehole is supported by casing or filter and the remaining annular space between borehole wall and casing is plugged.

In order to prevent undesirable inflows the borehole is sealed with cement and clay, which is backfilled into the annular space. In the areas of the water-bearing layers to be made use of, graded filter gravel is inserted.

Following the clean up and a thorough development of the well, the third step consists of equipping the well with an adequate pump and the corresponding flow metre and control technologies (MSR).

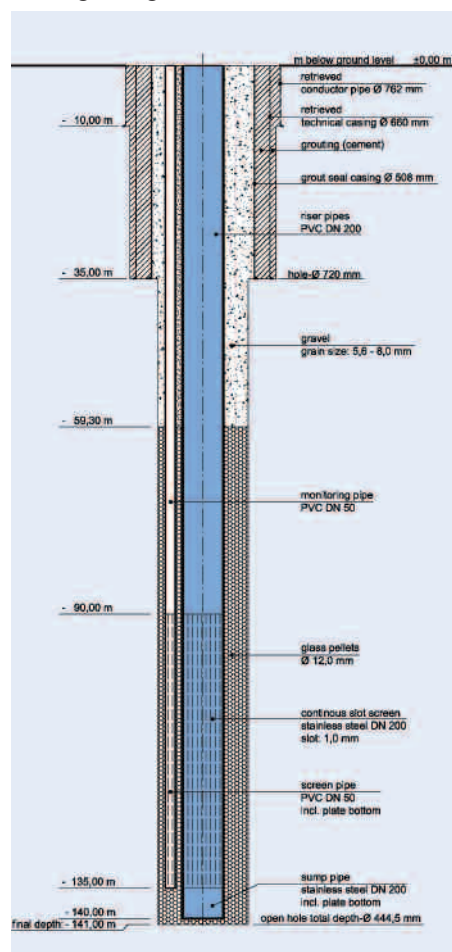
From this point on sufficient ground water can be produced from a high quality production facility.

The handling of this sensitive interaction of

- borehole (diameter...)
- filters (material, size of slots...)
- gravel (grain...)

and the appropriate dimensioning of the pump requires decades of experience and knowledge in dealing with well constructions.

This is what we stand for with our experience of more than 140 years in well construction. The basis for this is, on the one hand, the technical documentation of wells we have constructed in the last 60 years. On the other hand, our capability is supported by our well-trained expert staff and the modern equipment and techniques. Since carrying out the work in an accident free and environmentally sound manner is of particular concern to us, our employees have been trained and tested in all safety practices.



Example well drawing



Worker installing a casing string

The entire company has been certified within the framework of the management system SCC (Security Certificate Contractor).



## *The appropriate drilling method for the individual demand*

Apart from the accurate planning of a new well by our respective clients, the most important factors for the successful implementation of your project are our well-trained and long-serving employees of many years, as well as reliable and modern equipment.

We complete wells for you according to all established drilling methods, depending on the geology. This includes wells using flush drilling methods, air lift drilling methods, dry drilling methods (cable drilling methods), as well as hammer-techniques. Depending on the respective drilling tasks, diameters

can range between 1.50 m and approx. 100 mm.

Basically, drilling methods can be differentiated according to two criteria. These two groups include, on the one hand, the methods of percussion drilling and, on the other hand, those of rotary flush drilling.

### **Percussion Drilling**

This term includes all drilling methods which allow a mechanical lifting of drill cuttings, without any circulation of scavengers such as air, water or other liquids. Percussion drilling techniques are often used when undisturbed samples are required.

### **Rotary Flush Drilling**

The proceedings which fall into this category include all drilling techniques that are characterized by continuous lifting of cuttings by means of different circulating fluids.

Irrelevant thereby is the manner of destruction of rock (by rotation, by jarring or by a combination of both) as well as the manner of lifting:

- whether the lifting happens directly through the pipe
- or indirectly through the annular space.



Two-shift drilling operations



The construction of every well is unique in its own way.

The interplay of given geology, resulting different compositions of water and its yield, together with the future construction itself, requires accurate planning in the development stage.

Thereby our technical implementation is not only dependent on geology, but it always fits in with the wishes of our clients and/or the respective engineering firm as well.

Ultimately, what determines the success of a project is thorough planning previous to the start of construction as well as working hand-in-hand of all parties involved.

For preserving the productive efficiency of the well for many years following the construction phase, you will find in us the right partner for follow-up assistance.

We will attend, supervise and maintain your well.



Well drilling rig 400kN



## *Advantages of percussion drilling*

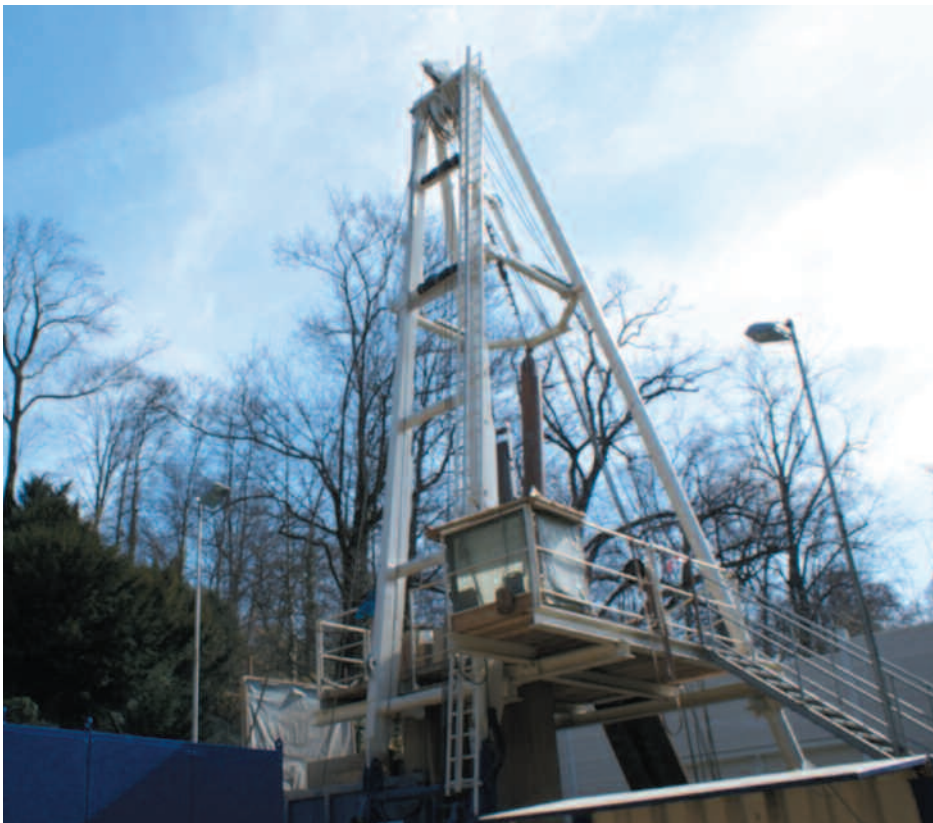
In case of low lying water levels the percussion drilling technique is often made use of for the construction of mineral water wells.

Advantages of the percussion drilling technique:

1. Simple and robust equipment technology
2. Applicability in most soil- and rock-residuals
3. A high verticality of the borehole even in unfavourable formations
4. Allows a very accurate exploration of water (direct correlation of inflows, geology and water level layers)
5. The only reasonable procedure for drilling of large diameter in fragmented solid rock and with very deep water levels
6. No addition of mud components in sensitive explorations
7. Percussion drilling does not require any circulation, therefore it is also applicable in case where fluid losses would occur.

With our percussion drilling rig we are able to reach depths as far down as 500 m, depending on the respective diameter.

Anger's percussion drilling rig in operation



## *Horizontal filter wells – a new service sector*

Horizontal filter wells are used to draw ground water from higher aquifers through drilled filter strings.

As a rule, several horizontal filter strings are produced from a vertical, impermeable shaft.

These filter strings can be arranged radially and at different layers of depth, depending on the layering and height of the aquifers.

In this way water can be produced specifically from limited horizontal layers.

In many cases the capacity of a single horizontal filter well with several strings can be much more than that of one vertical filter well.

Ideally, one horizontal filter well can thus replace an entire vertical well gallery.

The greatest difference between horizontal and vertical wells clearly is the alignment of their socket strings. Whereas vertical sockets, as a rule, go through several layers of aquifers and thus may produce ground water of different qualities, horizontal sockets on the other hand can produce ground water of a much more consistent quality.

This can have positive effects on the in-line cleaning.

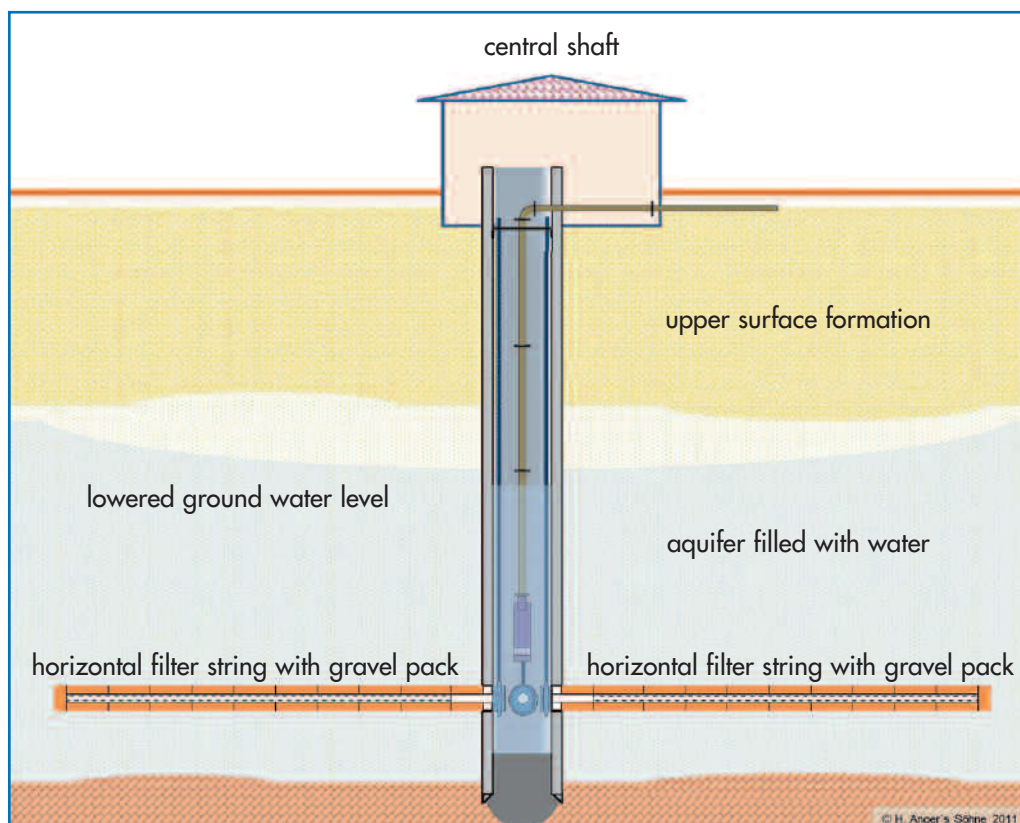
A horizontal filter well often represents a better economical alternative compared to a gallery of vertical wells when, e.g., large amounts of

water are to be produced from an aquifer with only limited height.

The large well cylindrical surface has positive effects on the ageing of the well and, subsequently, on the costs of maintenance.

This, and the possible higher energy efficiency of the production technology installed result in a positive cost-benefit analysis in the long run.

Additionally, the new equipment technology of H. Anger's Söhne for horizontal wells uses water hydraulics in order to meet rising environmental protection demands.





## Refurbishment of wells

Every structure is subject to the phenomena of deterioration and of wear and tear in the course of the years and well construction is no exception here.

If your well experiences a decline of its original productive efficiency, in many cases regeneration processes will help to restore its original power almost entirely.

If it proves to be impossible to restore the decrease in power, stability losses or problems of density via regeneration processes, the only way to preserve the well is to refurbish it.

Given the uniqueness of every single well, as was mentioned above, and its possible changes throughout the years, the company is often confronted with the exciting question what can be expected with every metre they go further down.

The advantages of a well's refurbishment and the involved conservation of location are obvious:

1. All of the licenses regarding building and approval laws already exist
2. The water's composition is known
3. Measurement- and control engineering as well as mains exist

4. Performance data are known
5. Drilling costs will generally be minimal
6. Prompt execution

Once the decision for a partial or entire refurbishment of the well is taken, in co-operation with the client and the respective engineering firm, different possibilities of how to proceed do arise.

Previous to determining any further production steps, a geophysical exploration should be carried out in order to obtain at least some basic information to allow the refurbishment to be planned effectively.

- repair pull-out casing
- insertion casing
- drill out
- wash over
- displacement

In case the well has already been highly affected by mineral deposits over a longer period of time, it is generally assumed that the obstruction extends through filter and gravel far into the soil or rock layers.

In this case a change of filter gravel or measures in the original bore hole would not suffice to dispose of the obstruction in the soil layers. In order to remove all deposits

leading to the loss of power, the appropriate proceeding would be a wash-over of the well with a larger diameter.

When one is facing a high level of sand encroachment in the well, changing of filters and/or filter gravel often may achieve the desired success, since the reason for the sand encroachment of the well may only be a wrong dimensioning at that time.



Drilling rig 500 kN