

The Etschel JET Master®

– a High Pressure Impulse Process (**HPI- Process®**) for water well rehabilitation and water well development



Well development with the JET Master®

The technology to create high pressure impulses by means of high water pressure for loosening of deposits in the water well, which clog the filter screens, the gravel pack and the borehole wall is described in the DVGW (German Water Certification Authority) Handbook Section W 130 as a high pressure impulse process (**HPI- Process®**). This **HPI- Process®**, which has been developed by Etschel Brunnenservice GmbH for more than a decade has proven itself in over 4000 water wells as a very successful method to rehabilitate old or develop new water wells very efficiently. In the following the **HPI-Process®** powered by the **Etschel JET Master®** will be described based on actual research and practical experiences.

Process Description

Using the HPI Process the potential energy (pressure) created by a high pressure pump is transformed into kinetic energy (water exit speed). The technical parameters of the **Etschel JET Master®** represent the basic conditions for the following:

According to the DVGW Handbook section W 130 the **HPI-Process®** is described as:

High Pressure Impulses

The kinetic energy created by the nozzles leads to the counter directional rotation of the two jet nozzle bodies at very high speed generated by a recoil effect. The extreme water exit speed of 180 meter /second together with the jet power of the individual nozzles of about 190 KN lead to a sudden acceleration of the water (Impulse) around the nozzles. This initialises **high pressure impulses**, which expand from the surrounding well water through the filter screens and the gravel packing into the aquifer .The high energy input creates micro movements, which lead to the breaking up of deposits between the individual gravel particle, since they start rotating.



Creation of High Pressure Impulses

Consequently the efficiency of the **HPI-Process®** is based on the creation of a high flow velocity within the well water and the gravel filter layer by using the shearing power of the water to loosen any kind of deposits. The generated high pressure impulses travel in a more or less horizontal direction deep inside the water well. On top of that the two counter rotating nozzle pairs, which are adjusted to the individual well diameter separate almost completely the water into two water horizons. Due to the constant up and down movement of the entire aggregate at a speed between 0,1m/s to 0,3 meter/second during the rehabilitation or development process a swab effect is generated, which further contributes to the cleaning of the well.

Official investigations and research have proven that the described swabbing effect along with the generated suction lead to a transport of the loosened deposits into the water well, while simultaneous pumping extracts the solids from the well.

Extraction of loosened deposits

To further increase the efficiency of the well cleaning process and to get hold of measurable data of loosened deposits a submersible pump is installed, which continuously extracts the loosened particles together with the well water simultaneously to the **HPI-Process®** taking place. There, it is absolutely necessary to adjust the pump performance to the well characteristic, since in case of a low flow less perched water horizons will not be activated.

In addition to the swab effect the pump generates a flow pattern from the aquifer through the gravel packing and the filter screen into the well. This leads together with the positive shock wave impulse and the effective tractive force towards the well to the flushing of the channels between the individual gravel particles. The higher the flow velocity towards the well, the higher cleaning effect can be observed, however the flow velocity should be controlled as such to avoid a change from laminar flow to turbulent flow.

Measurements

To control the progress and success of the **HPI-Process®** with the **Etschel JET Master®** and to determine the break up criteria continuous measurements are necessary. Those are typically made by measuring the loosened and pumped out deposits in regular intervals according the requirement of the client (for example every 5 minutes). The measurement readings are recorded from the deposit settlement in Imhoff cones. As soon as the readings show a stabilization at a very low level of the pumped out deposits the process can be stopped.



Measurement of extracted solids and taking samples



Extracted solids

Planning

To obtain best results planning of the **HPI-Process®** is vitally important and should amongst other factors include:

- calculation of pressure losses in High Pressure hoses and technical installations
- calculation of the efficient length of the nozzle jet dependant on the nozzle diameter
- calculation of the nozzle jet velocity dependant on the distance between the nozzle and the filter screen
- dimensioning of the nozzles
- water well depth and well diameter.
- Condition of Filter screen material and the water well in general

Practice has shown, that TV inspections of the water well at least before and after the cleaning process are highly recommendable.



TV-inspection

Third party and own scientific research

For a better understanding of the **HPI-Process®** and to obtain solid data for the technical improvement of the **Etschel JET Master®** itself the following R&D projects have been executed since putting the Jet Master into operation back in 1993.

- Own research

Tests in conjunction with a thesis at the Bergakademie Freiberg (SAAED, 1996), which as a result has led to further improvement of the **HPI-Process®** and an increase of the penetration depth beyond the filter screen.

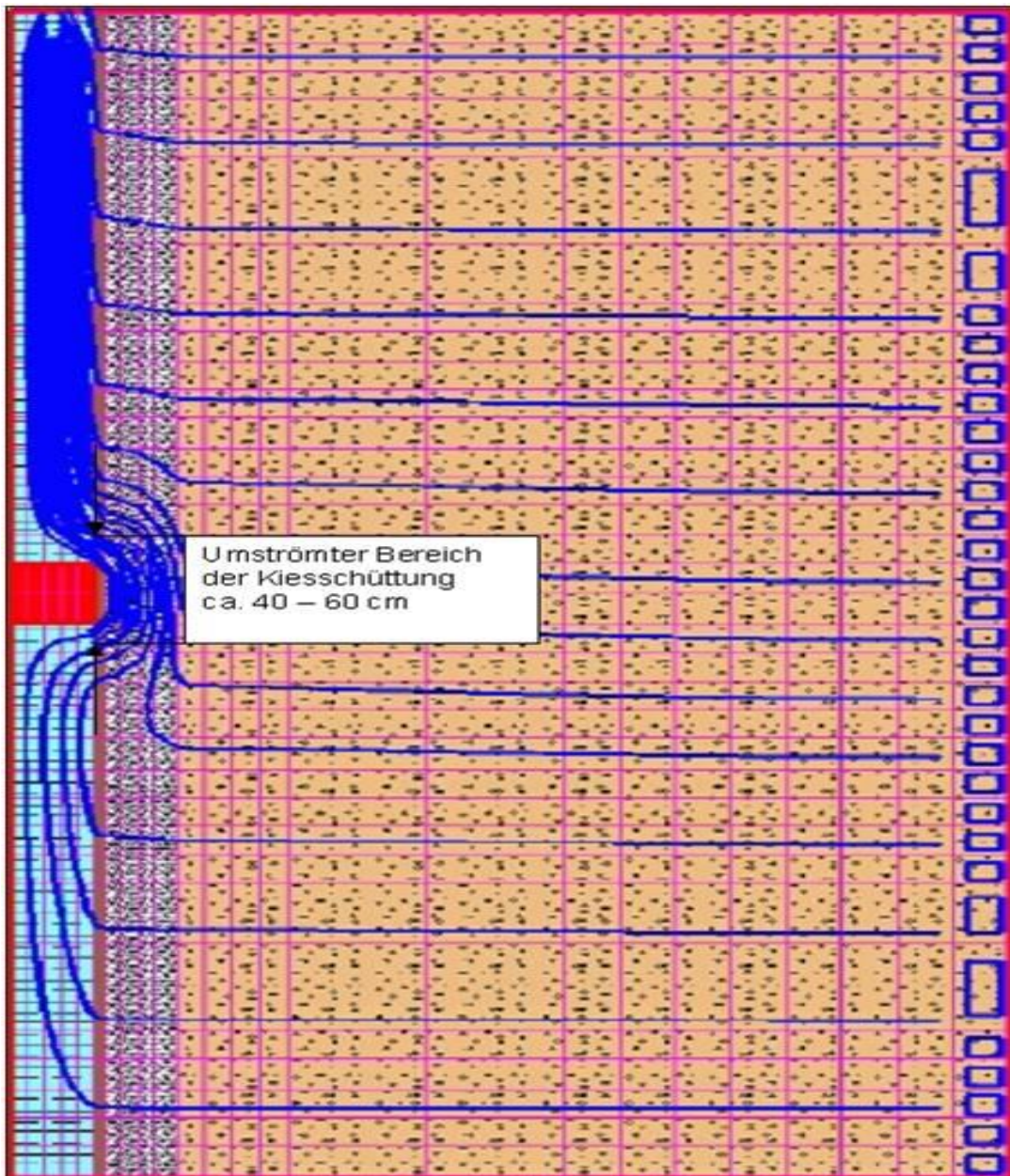
In some cases we have extracted Bentonite and other drilling fluids from old wells which under normal circumstances should have been extracted when the well was developed. This serves as a proof that the created impulses reach even beyond the borehole wall. In such cases it often happened, that the performance of the well exceeded the one after the final pump test of the newly drilled well.



Extraction of Bentonite while developing a well with the JET Master®

- Third party research

In conjunction with an updated edition of the **DVGW** (German Water Certifying Authority) handbook section W 130 (Water Well Rehabilitation Techniques), which should take into consideration the state of the art rehabilitation techniques an official research programme was initiated by the **DVGW** in the year 2000. The goal was to compare the various mechanical rehabilitation techniques and verify their efficiency, by determining their penetration capabilities beyond the filter screens into the gravel pack. The investigations were carried out at the Dresdner Grundwasserforschungszentrum e.V. (**Dresdner Groundwater Research Centre**) on real well models. The results have been finalised in 2003 and were published in the **DVGW** Research edition W 55/95 in which the **HPI-Process®** has achieved best results, compared to other rehab methods.

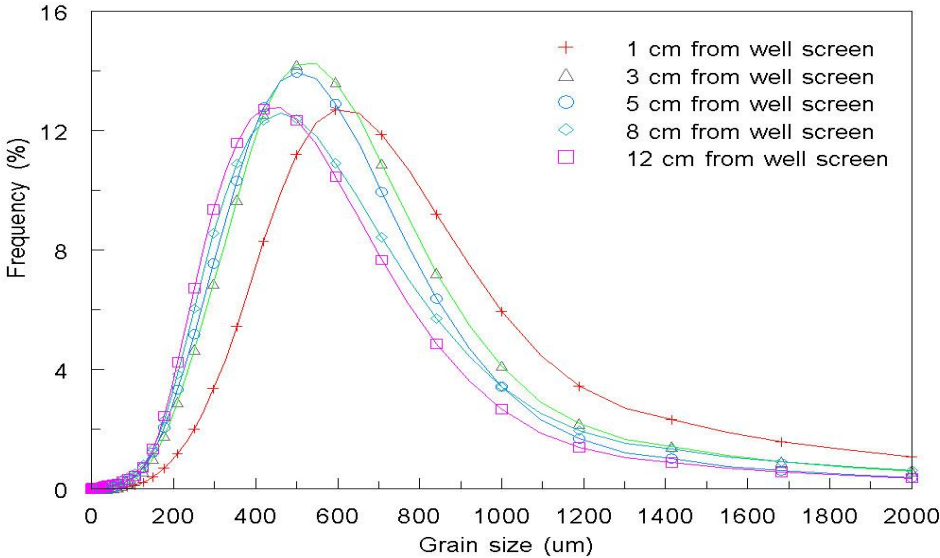


Penetration of High Pressure Impulses through Filter screen up to the borehole wall and into the aquifer

A further test of the actual efficiency of the **HPI-Process** with the **Etschel JET Master®** was carried out by the Dutch Water Certifying Authority (**KIWA WATER RESEARCH**). This test shows the efficiency of the **JET Master®** during well development in sandy aquifer, without gravel pack and Johnson screens.



KIWA Test in a Container



Extracted sand by the JET Master®



Natural gravel development up to 12 cm from well screen

Etschel JET Master® System Technology

For the majority of applications (wells up to 1000 mm diameter and until 400m depth) the entire equipment is installed on a three axle four wheel truck configured by our own factory.

The high water pressure is generated by a plunger pump. The flow can be regulated between 100 and 200 l/min (6 to 10,2 cbm/ hour). The pump pressure can be regulated in range between 100 and 560 bar according to the requirement. The Truck is completely equipped with its own power supply, a compressor, various nozzle configurations, distance holders, control instruments, high pressure hoses, riser pipes, various pumps, hydraulic accessories and data recorders. To operate the **Etschel JET Master®** external water must be made available on site.



Well Rehab with the JET Master®

Applications

The applications of the **Etschel JET Master®** are variable. The **HPI-Process®** is mainly used for water well rehabilitation of vertical water wells, pump shafts, horizontal water wells, infiltration wells, observation wells and similar applications, but also for the development of new water wells and de-sanding. In only a short time most particles (e.g. sand, loosened deposits, sludge, sintered materials a.s.o.) are removed from the well and the sump.

Because of the flexible adjustment of the applied pressure, the rotational speed and the nozzle distance to the filter screen, the **Etschel JET Master®** can work in all known Filter screen materials. Even in very old wells the **HPI-Process®** has proven to do a successful job.

It is vitally important for many water well operators to have a minimal break down time of the well production for a rehabilitation. In many areas it is almost impossible to take the well off the supply network for a longer time. In most cases the **Etschel JET Master®** does not need more than 1 or two days to rehabilitate a well successfully. Including the pulling and installation of a pump as well as a TV inspection of the well before and after applying the **HPI-Process®**, the total time consumption in conjunction with wells up to 200m depth does not exceed 4 or five days. Deeper wells may take longer.

It is only natural, that in some cases the rehabilitation makes eventual damages (e.g. corrosion, mechanical damages a.s.o.) of the water well construction or the filter screens itself visible. In such cases the water well rehabilitation can serve as an indicator of preventive maintenance, giving the operator a clear proof, that a sanitation of the well may be highly recommendable. This can save a lot of cost versus the costly and time consuming possibility to have a new well drilled.

Monitoring

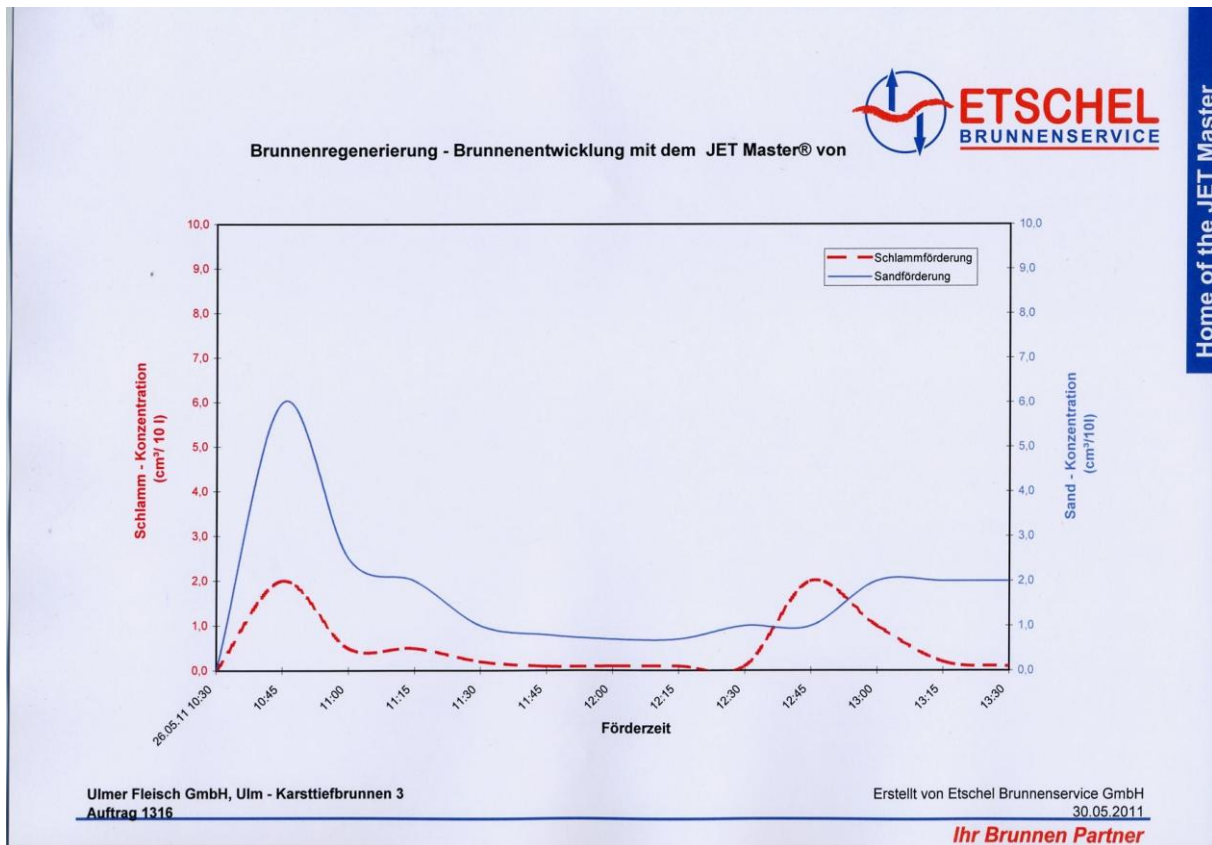
At the beginning of the **HPI-Process®** a great amount of sludge extraction can be observed, which is caused by cleaning the casing and the filter screens including the slot openings.

After a while the extracted sand concentration increases, since due to their mass they require a longer time to be “mobilized” by the **HPI-Process®**.

After continuously applying the process the sand and sludge transport falls pretty steady.

By increasing the pump capacity in the next step one can observe another increase of sludge and sand extraction from the well.

Finally when the extracted particles reach a stabilized level of no more than 0 to 0,5 ml per ten liters this serves as an indicator that the break up criteria for the **HPI-Process®** has been reached.



Extracted sand and solids from a well

Thereafter another specially designed pump is installed and lowered into the bottom of the well to finally clean the borehole sump of deposits which have sunk during the process and could not be extracted. The extracted amount of deposits is also measured and will be shown in the extraction graph.

Water well maintenance after the rehabilitation

In a best case scenario the **Etschel JET Master®** using the **HPI-Process®** should not be a one off single approach towards proper well maintenance. A water well is a costly building, which under normal circumstances should be monitored in regular intervals by the owner. The little effort can save a lot of cost in the long run. Elements of a proper water well maintenance scheme should include:

Regular Eye Observation of: (every month)

- the pump house and well shaft
- the hydraulic and electrical installations in the well shaft
- the pump and its riser pipe

Judgement of the water well itself by (interval to be determined)

- TV inspections
- Geophysical measurements

Assessment of the hydraulic and chemical parameters (interval to be determined)

- by pump tests
- by water analysis

Assesment of the well performance (weekly or monthly) by:

- Measurement of the still water level (pump is off)
- Measurement of the draw down water level (pump is on)
- Measurement of the running times of the pump
- Measurement of the sand content and other materials (gas,gravel etc.) in the pumped water

The records of this data should be filed and serve as an indicator, that a rehabilitation as part of preventive maintenance may be adequate, once a significant deviation from the new condition is observed.

The DVGW handbook W 130 recommends that a rehabilitation is an urgent need and can achieve best results once the well has lost between 10% and 20% of its productivity.

CONCLUSION

The **HPI-Process®** powered by the Etschel **Jet Master®** using US patented **MAXINOZ®** rotational system Nr.9,366,113B2 is a proven and chemical free technology to mechanically rehabilitate old wells or develop new wells after the borehole has been drilled. With over 5000 rehabilitated wells and several hundred well developments, we belong to the most experienced companies in applying the **JET Master®** in the field, making it the state of the art rehab technology in Europe, which makes us the right partner to talk to. In many cases this process makes a questionable chemical treatment an unnecessary exercise.

- **time and cost saving solution**
- **high cleaning and solid extraction performance**
- **Proven state of the art technology**
- **High penetration beyond the filter screen**
- **Measurable results**
- **Proven success in all well known filter materials**
- **Enduring process performance**
- **Creation of positive cavitation leads to disinfection of the well already during the rehabilitation and contributes to a slow down of bacteria growth**



- State of the art JET Master® rehab site

See also our videos about water well rehabilitation and water well development published on YouTube.

We manufacture “custom made” JET Master units either truck mounted or container mounted according to your needs or we accompany you by building your own.

The following are registered Trademarks of the mother company of Etschel Brunnenservice GmbH



HPI-Process

MAXINOZ®

Literature:

SAED, M. (1996) Vorbereitung und Durchführung von Modellversuchen für die Brunnenreinigung unter Verwendung von Wasser mit hohem Druck

Paul, K.F. (1999) Überwachungsmethoden im Bereich der Brunnenregenerierung . DVGW Schriftenreihe Wasser Nr.93, Bonn

Johnson Division „ Jet Development does the work“ – Reprint from Nov./Dec. Edition 1961 of National Drillers Journal

Treskatis, C.&Leda, M. (1998) Brunnenregenerierung – Anwendung Mechanischer und chemischer Verfahren am Beispiel von Flach- und Tiefbrunnen am linken Niederrhein – bbr, Ausgabe 9, R.Müller Verlag, Köln

Licht, Treskatis & Knopf (2001): Einsatz der gesteuerten Horizontalbohrtechnik im Brunnenbau – bbr, Ausgabe 1, R.Müller Verlag, Köln

Etschel C. & Schmidt M. (2001): Das Druckwellenimpulsverfahren für die Regenerierung und Entwicklung von Brunnen.- bbr, Ausgabe 4/2001, R. Müller Verlag, Köln.

DVGW Merkblatt W 130 Technische Mitteilung Brunnenregenerierung, Juli 2001

Dresdner Grundwasserforschungszentrum e.V., Abschlußbericht Forschungsvorhaben , 2003

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