

New developed bi-rotational-unit significantly increases results of water well rehabilitations using the HPI-Process® with high water pressure



Cover: JET Master® rehabilitation unit

Practical tests of new bi-rotational unit MAXINOZ® in all common filter screen materials all over Germany have been completed.

As the water procurement company for the Rhine-Main region, Hessenwasser operates a regional pipeline network with around 350 kilometers of supply lines - a complex infrastructure for sustainable water supply in the Frankfurt/Rhine-Main metropolitan region.

This infrastructure enables to balance the availability of water between these regions and the need of high quality water in the cities and municipalities can be ensured. Professional competence and foresight ensure that the region can be supplied with drinking water of high quality efficiently and reliable in accordance with the ecological requirements. Good for the region as high quality drinking water is a precondition for a healthy life and the economical performance of every community [1].

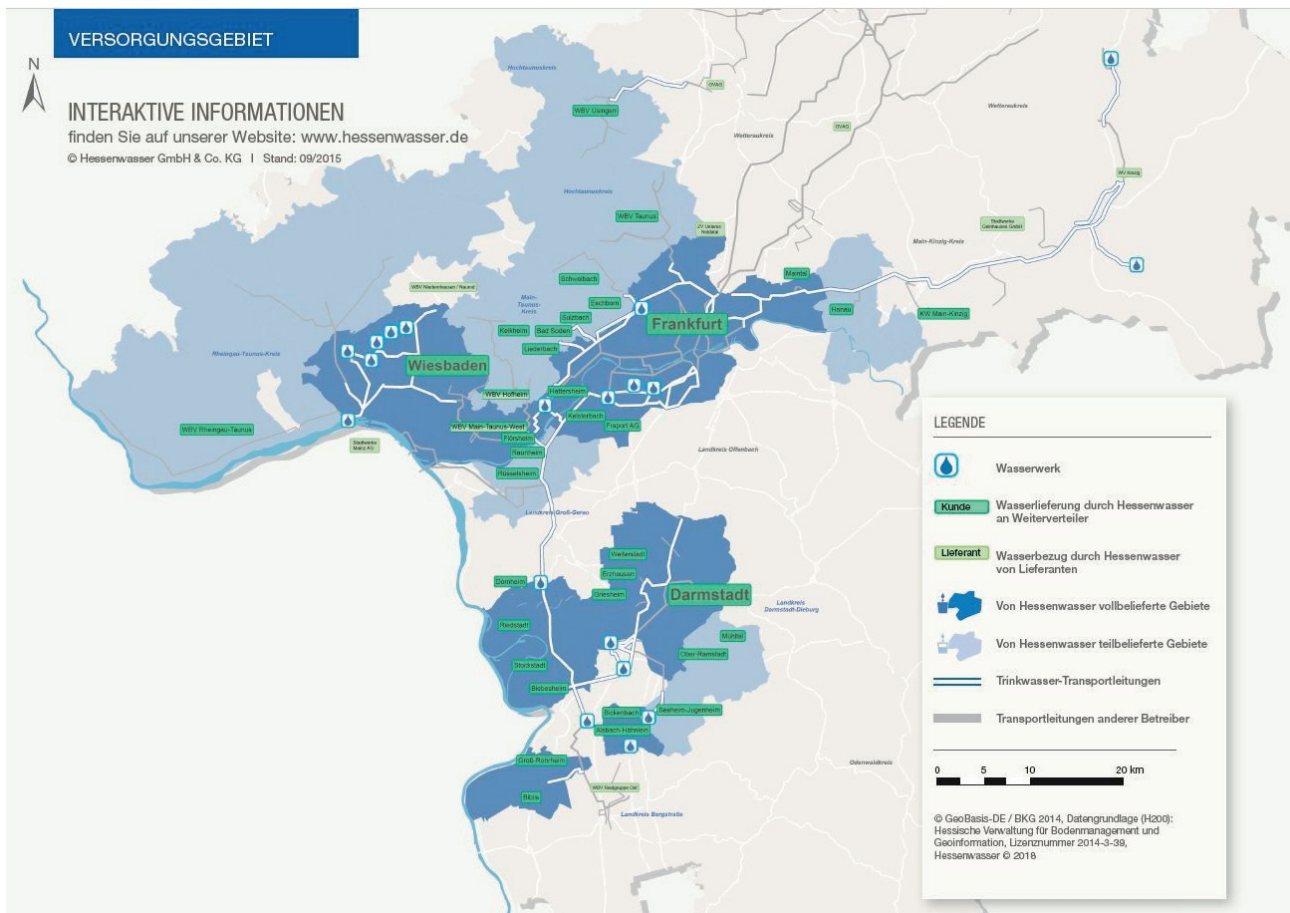


Fig.1 Supply area of Hessenwasser

Hessenwasser is responsible to supply cities, municipals and other suppliers in the metropolitan region Frankfurt Rhine /Main with drinking water. The regional pipeline network supplies the major cities of Frankfurt, Wiesbaden and Darmstadt as well as a further 50 municipalities and associations in the region with drinking water in whole or in part. The transport of the water is a huge logistical challenge which is mastered by a system of nearly 350km pipes. There is a yearly supply of 112 million m³ water for more than 2,4 million people. This makes Hessenwasser one of the ten biggest water suppliers in Germany. The extraction plants of Hessenwasser are distributed over the entire supply area - from Hessen Ried, Vogelsberg, Spessart and the greater Frankfurt area to the Taunus tunnels and the waterworks in Wiesbaden-Schierstein. At this time there are 21 water works in operation with 192 wells, springs and tunnels [2].

Such a huge supplier needs to maintain his wells as soon as a loss of performance is determined. This means, that the wells need to be rehabilitated regularly to keep the performance. In the supply area of Hessenwasser, many wells lose capacity due to natural aging processes which leads to loss of the specific capacity, as mentioned in the DVGW W 130. Therefore, Hessenwasser decided to test divers, modern rehabilitation methods from

different providers in 2018. In the test area, the wells are subject to strong iron and manganese deposits, which impair the well performance. The goal was to identify preferred rehabilitation methods of different providers in terms of efficiency and application knowhow.

In this context, Etschel Brunnenservice was commissioned to rehabilitate one of the wells. It was a 50m deep well which was drilled in 1963 equipped with DN400 diameter wood (OBO) filter screen.

It was decided to get the well rehabilitated with the conventional bi-rotational UNINOZ®-system which creates the High-Pressure-Impulse-Process® with high water pressure and is well known on the market. As a second step, the well should be surge plugged. With the UNINOZ® unit, the high pressure impulses are generated in exactly horizontal direction to the vertical axis of the well.

In addition to pumping tests before and after rehabilitation, geophysical measurements were also carried out at the well. According to these measurements, a specific capacity of 26 cbm/hr/m drawdown at a flow rate of 110 cbm/hr was determined before rehabilitation with the JET Master® system. After the rehabilitation with the traditional UNINOZ®-system, an unexpected performance increase of 58% (specific yield 41,3 cbm/hr/m drawdown) was measured. The entire solid discharge was carried out during the rehabilitation with the HPI-Process® with high water pressure. The surge plugging which was carried out afterwards, could only mobilize a small quantity of sand (Abb.2).

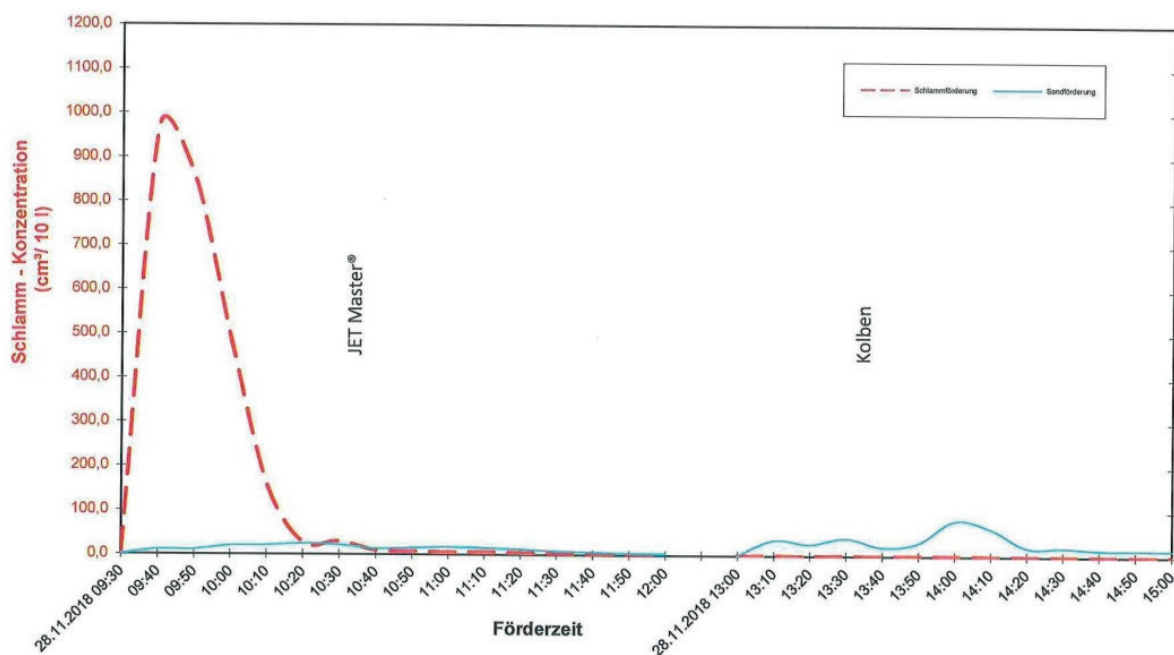


Fig.2 Solids discharge Br.49 Eschollbrücken

Based on the results from the entire test series with various providers and processes, Hessenwasser has declared the HPI-Process® with high water pressure as one of the preferred processes.

Due to the recognitions of the test series in 2018, Etschel Brunnenservice was commissioned for the first time to rehabilitate two wells of Hessenwasser only one year later. For the two agricultural wells with depths of around 90 meters, three different rehabilitation methods according to DVGW W130 were alternatively inquired: surge plugging (with moving chamber), 20hrs. – Intense pumping with shocking, 5hrs. – and the HPI-Process® with high water pressure, 8hrs. The indicated operating times of the different processes refer to the treatment of both wells. Prior to all processes, the wells should be brushed in a pre-cleaning process.

At this time, the operator decided to rehabilitate the wells with the new patented bi-rotational unit **MAXINOZ®** by using the HPI-Process® with high water pressure, which already exists a few years on the market and was provided by Etschel Brunnenservice exclusively. The difference to the conventional UNINOZ®-system is, that the angle of the **MAXINOZ®** bi-rotational unit can adjust the angles of the nozzle configuration to the specific filter screen material. For Etschel Brunnenservice GmbH, this order meant the conclusion of the nationwide practical application series of this new unit, as PVC filters had not yet been rehabilitated with it. Since 2016, all other materials used in well construction have already been treated with the **MAXINOZ®** system in a nationwide test series lasting several years (see various publications, Table 1).

Project	Diameter	Depth (m)	Filter screen material	Result
Markt Mering, TB 1	DN400	155	Glued-gravel bridge slotted steel	Increase of specific capacity by using MAXINOZ® 61% higher in comparison to UNINOZ®
Stadt Delbrück, Br. 6	DN500	26	Johnson Type	Well performance 33% higher by using UNINOZ® [4]; subsequent MAXINOZ® rehabilitation: 93% (WasserMeister 04/2019)
WV Bayerischer Wald, Br. V4a	DN750	11	Johnson Type	Well performance of 20% by using high pressure brushing with gas; subsequent MAXINOZ® rehabilitation 229% [5] (gwf 04/2017)
WV Bayerischer Wald, Br. V4a	DN750	11	Johnson Type	Same well as above with optimized configuration; another increase of well performance of 23,6% using MAXINOZ® [6] (WasserMeister 02/2019)
Gemeinde Aichhalden, TB 1	DN350	98	Wood Filter Screen (OBO)	Well performance increase of 563% using MAXINOZ® - lowering 26,08 m less [7] (WasserMeister 01/2020)
Stadtwerke Karlsruhe, 10 wells	DN400 – 800	40	Johnson Type, coated steel, and stone filter screens - double gravel pack	Average well performance increase of 152,5% using MAXINOZ® [8] (ewp 05/2017)
Landeswasser-versorgung Baden-Württemberg, Development	DN500	12	Johnson Type	Development of 6 new wells from which 3 were developed with UNINOZ® and 3 with MAXINOZ® ; average 970% higher sand extraction with MAXINOZ® [9] (bbr 09/17)

Table 1: documented and published rehabilitation- and development-results with MAXINOZ®

The order from Hessenwasser in Lampertheim was based on the following well data:

Well	Constructed in	Diameter	Depth	Filter area	Q spec.	Static water level
Nr. 3	1982	DN4 00	96,0 m	50 m	38,9 l/s	-3,39
Nr. 4	1982	DN 400	91,0 m	51 m	38,9 l/s	-3,53

Table 2: Well data Lampertheim

In particular it is worth to mention that both wells were drilled with a diameter of 800mm and have a double gravel pack (5-8mm inside; 1-2mm outside).

In every well, the whole filter screen area is divided in 5 segments. In addition to the actual rehabilitation, pumping tests and geophysical measurements by means of packer flowmeters, each before and after the JET Master[®] rehabilitation, were tendered by Hessenwasser and carried out by the contractor.

During the removal of the pumps, severe clogging was already detected on both risers and pumps, which were also cleaned in the course of the contract execution.



Fig. 3 clogged pumps

The severe clogging of both wells after 37 years of operation was also evident in the TV surveys prior to rehabilitation and the solids discharge values determined during rehabilitation. In well three, 0.16 cbm of sand and 1.29 cbm of solids were discharged at a total flow rate of 226.80 cbm of water by means of the HPI-Process with high water pressure using the **MAXINOZ**® rotational unit within only three hours of rehabilitation until the termination criterion according to DVGW W 130 was reached. In the case of well four, these values amounted to 0.50 cbm of sand and 1.04 cbm of solids with a total flow rate of 288 cbm of water and a total rehabilitation time of only 4 hours.



Fig. 4 Solids discharge on a cover

The rehabilitation results achieved by using the HPI-Process with high water pressure, in this case the bi-rotational **MAXINOZ**® unit, differ significantly from the operator's previous experience with the rehabilitation processes known to him. The performance increases achieved are enormous and will ultimately lead to a significantly improved sustainability of the measure (extended rehabilitation cycles). Due to the extraordinary positive performance increases achieved by the JET Master® system, it may be assumed that both wells could not be developed ideally at the time of drilling. Unfortunately, no pumping test data from the new construction were available for this purpose, which would allow a comparison with the results of this rehabilitation. In this case, however, it can be assumed that the well was post-developed with integrated rehabilitation.

Well	System	Q spec. before rehab.	Q spec. after rehab.	Performance increase in %
3	MAXINOZ	8,62 l/s/m	21,27 l/s/m	246
4	MAXINOZ	3,98 l/s/m	16,39 l/s/m	411

Table 3 rehabilitation results Lampertheim

After rehabilitation, the well sumps were cleaned by airlift pumping and the investigations mentioned above were carried out including TV inspection.

For Etschel Brunnenservice GmbH this means the completion of several years of practical application and the proof that the new and patented nozzle rotational unit **MAXINOZ®** can be used nation- and worldwide in all major screen materials.



Fig. 5 example: **MAXINOZ®** bi rotational unit with adjustable angles.

For water suppliers and other well operators, according to the current state of knowledge, the use of this new rotational unit can in many cases achieve significantly improved performance increases on wells in the context of rehabilitation than with the previous High Pressure Impulse Process® with high water pressure (system UNINOZ®) and other comparable processes. Also worth of noting for well operators is the very short operating time (see above) required to achieve the desired rehabilitation result. The additional price for this innovation is compensated in most cases in comparison to the often days-long application of other processes. As a result, the well to be treated can be reconnected to the network and pump water much sooner.

Conclusion:

The new nozzle rotation unit **MAXINOZ®** for the application of the HPI-Process with high water pressure (JET Master® system) represents a meanwhile tested alternative for well developments and well rehabilitations, which can lead to significantly improved Q-spec. results and thus longer sustainability of the measures.

Acknowledgements: We would like to thank Hessenwasser, especially Ms. Schreiner and her colleagues for having the courage to try something new for once, as well as for the professional cooperation with the operator's staff.

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Table 1 - 3 Etschel Brunnenservice GmbH

Fig..1 Hessenwasser

Cover, Fig. 2 to 5 Etschel Brunnenservice GmbH

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