New Large Scale PRB Network RUBIN Launched in Germany

Volker Birke, Harald Burmeier and Diana Rosenau[1]

Abstract: In addition to SAFIRA, the already running German network for basic PRB R&D work (since 1999), another novel initiative focusing on actually technical PRB implementations was set up last year: The German Ministry for Education and Research (BMBF) launched RUBIN, the large-scale joint R&D and implementation program for the "Use of Treatment Walls for Site Remediation" in Germany. RUBIN stands for (in German) "**R**eaktionswände **u**nd -**b**arrieren **i**m **N**etzwerkverbund" meaning in English "reactive wall and barrier projects co-operating in a network".

Although a growing number of demonstration sites for permeable reactive barriers (PRBs), predominantly involving treatment of chlorinated ethylenes by granular iron metal, have proven successful in principle worldwide, so far PRBs have not been fully accepted and therefore established as new general remediation technologies. The lack of general acceptance and missing incentives to implement PRBs in full scale and in a wide scope are due to, among other things, still insufficient or missing comprehensive reliable information on long-term aspects, e.g. longevity, long-term effect and performance, and, associated with these items, the overall rentability.

In Germany, a few pilot PRB projects have been implemented over the last four years revealing promising temporary results. Therefore, it was decided by the Federal Ministry of Education and Research to evaluate and assess the performance as well as other material issues to a greater extent and in a broader scope within the upcoming years by implementing the novel network RUBIN.

Several general targets to be achieved over the next years were defined: RUBIN is an interdisciplinary R&D network focusing on fully technical implementations of PRBs in Germany. RUBIN is scheduled to deliver extensive information on and solutions for general and particular problems regarding design, construction, operation and environmental effects of PRBs as well as legal aspects and regulatory acceptance. Data have to be gained from as much as possibly different applications for assessing benefits, drawbacks and applicability of PRBs to groundwater remediation problems. Furthermore, with the help of RUBIN, experts will get an opportunity of testing thoroughly already running German PRB installations, especially pertaining to long-term performance. Quality standards will be set up, rentability of PRBs is going to be scrutinized and compared with the pump-and-treat technology.

RUBIN´s time schedule and financial scope is about 3 years and appr. 4 Mio EUR at least, resp. RUBIN consists of 12 single projects: 9 projects deal with setting up an actual PRB construction (see Tab. 1). 3 further projects are scheduled to tackle general issues and problems. The University of Tuebingen (Georg Teutsch) will scrutinize rentability of PRBs, and the University of Kiel (Andreas Dahmke) will deal with improved approaches for quality management, monitoring and preliminary examinations, especially focusing on elucidating degradation processes and finding out mass balances. The University of Applied Sciences (Harald Burmeier) coordinates the whole

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network and will be responsible for making up a general manual covering a main connecting thread for the planning, design, erection and operation of PRBs.

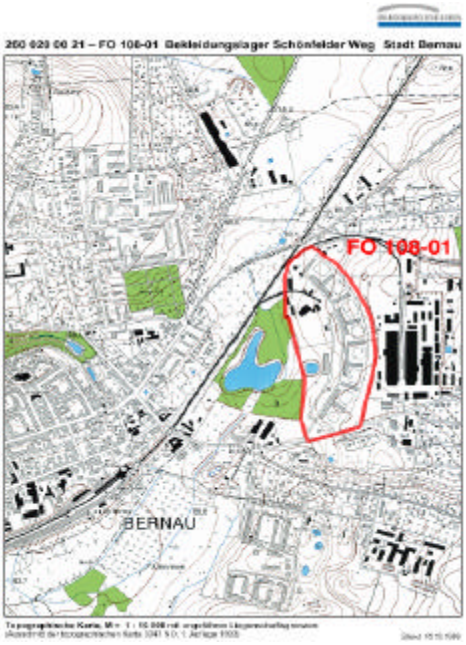

Figure 1 – Views of the Bernau site (northeastward of Berlin, location: closed big dry cleaning/laundry facility of the former Soviet Union army, 2 aquifers are highly contaminated by TCE). Photo #1 (Dec. 2000): place before starting the PRB installation. On the left, there are still storage tanks in place, which used to be charged with TCE. During a preliminary examination campaign at that time, Geoprobe Systems took samples for hydrogeological analyses at the site (photo #2).

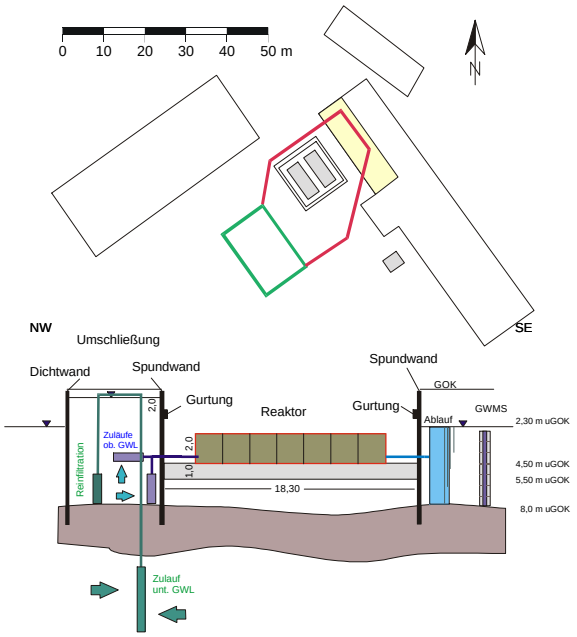

Figure 2 – Left, top: top view of the f & g system (closed funnel designed as a slurry wall = red line, gate = green line), below: elevation of the gate system = reactor; right (photos): set-up of the sheet pile and slurry wall (a combination of both was installed in Mar. 2001). Courtesy by M. Freygang (BBG mbH), P. Hein (INGAAS GmbH), L. Vigelahn (Technical University of Berlin).

	Bernau	Denkendorf	Dresden	Edenkoben	Hanau	Nordhorn	Offenbach	Rheine	Wiesbaden
Topic, pollution	In-situ cleansing of a TCE-contaminated GW applying the f & g principle utilizing regenerable Fe^0 reactors with a horizontal arrangement, single cyclindrical segments	Innovative down gradient remediation of groundwater polluted by TCE, PCE, cDCE and TCA on the premises of the trading estate of the town of Denkendorf	Investigations for the construction of adsorptive walls at uranium-contaminated sites, especially at Dresden-Coschuetz/Gittersee	Set-up of a monitoring program for the already existing full-scale f & g system treating TCE, cDCE, 1,1,1-TCA, make-up of operation instructions to be used in a manual	Developing of and testing reactive zones consisting of humic substances for the downstream decontamination of GW polluted by taroil (tie impregnation plant, Hanau)	Development of a combinated process for the remediation of GW polluted by mixed contaminants(dyes, DNAPL) stemming from a former textile factory/dyeing works	Development of and testing a reactor and a treatment wall for the removal of BTEX and PAH (former tar plant)	Evaluation of long-term behaviour of a Fe^0 reactive wall using the Rheine site and pilot PRB there as an exemplary case study for the long-term removal of PCE, TCE, cDCE	Development and evaluation of reactive wall systems applied to an arsenic contamination at an abandoned site being in touch with a river Rhine aquifer
Applicant	The Federal State of Brandenburg, BBG mbH, Waldstadt, Dipl.-Geol. Freygang	IMES GmbH, Amtzell, Dr. Schad	Technical University of Berlin, Prof. Rotard, Dipl.-Ing. Borrmann	Peschla + Rochmes GmbH, Kaiserslautern, Dipl.-Geol. Rochmes	VFT AG, Hanau, Dr. Bluemer	Administrative District (County) of Bad Bentheim, Dipl.-Ing. Zwartscholten	Hessische Industriemuell GmbH, ASG, Wiesbaden, Dipl.-Ing. Kayser	Mull und Partner Ingenieur-Gesellschaft mbH, Garbsen, Dr. Moeller	Hessische Industriemuell GmbH, ASG, Wiesbaden, Dipl.-Ing. Kayser
Wall System	f & g (horizontal flow); the source is entirely enclosed by a slurry wall	Drain and Gate	Still to be designed (will be based on the outcomes of this project)	f & g (vertical flow)	Permeable sorptive zone	Still to be designed	f & g	Continuous trench	Reactive zone at the upgradient, f & g downgradient
Reactive Material	Fe^0	Palladized zeolites, pelletized and hydrophobic Addition of hydrogen gas or Fe^0	Alternative adsorbents like brown coal, brown-coal coke; other adsorbents like zeolites Naturally occurring complexing agents (e.g. humic acids), technical agents (e.g. EDTA)	Fe^0 filings (exception: in the already existing gate the upgradient area is merely infilled) Activated carbon in the downgradient area of the still existing gate	Humic substances for sorptive removal of groundwater pollutants Injection of water-soluble humic substances into the ground and successive precipitation	Still to be found out: Microbiology combined with adsorptive materials and Fe^0	Microbiology plus activated carbon Addition of electron acceptors required for the microbiological degradation Activated carbon	Fe^0-sponge Granular grey iron/pea gravel mixture	<u>Plan 1:</u> Readily oxidizable C_{org}-phases, solid phases consisting of sulphate (both emitting sulfide) <u>Plan 2</u>: Iron oxide: adsorptive fixation

Table 1 – Overview of the 9 RUBIN projects dealing with an actual PRB installation, arranged by location in alphabetical order.