

IWRM-Indonesia Fact Sheet

Adapted Slow Sand Filter with intermittent operation as first step for the multi-barrier water treatment concept

General Data

Plant type:	Slow Sand Filter (SSF) with intermittent operation
Location:	Semanu, Kabupaten Gunung Kidul, Province of Yogyakarta Special Region, Indonesia (110.681611°E / -8.049990°S)
Operated since:	December 2014
Operator:	Perusahaan Daerah Air Minum (PDAM) Kabupaten Gunung Kidul (Gunung Kidul Water Supply Authority) (status October 2015)

Technical Data

Filter bed area:	25 m ² per filter, three filter units
Filtration rate of the filters	4 m/d (\approx 0.2 m/h)
Height of filter bed	0.8 m (minimum 0.5 m)
Specification of sand	Lava sand
Effective size d_{10}	0.25 mm
Uniformity coefficient C_u	3.06
Height of under-drains incl. gravel layer	0.25 m
Height of the supernatant water	1 m



1 Objective

In the frame of the IWRM-Indonesia R&D project, water quantity was successfully enhanced using an innovative approach in terms of underground hydropower driven water supply to deliver water from the 100 m deep karst aquifer without use of external energy. Thus, it was possible to secure the water supply for some 75.000 people. After the foremost problem was solved and water

quantity was enhanced, further questions had to be addressed such as water distribution, waste water treatment and water quality assurance.

Currently, the water provided by the above mentioned supply system is untreated and non-potable, and hence, needs to be purified. Based on intensive on-site investigations and monitoring measures, the necessity of a multi-barrier water treatment concept was revealed consisting of a central filtration process at the point of extraction (i.e. prior to the distribution network) which is mainly to remove suspended solid, a semi-central hygienization and a final treatment step at household level (point of use).

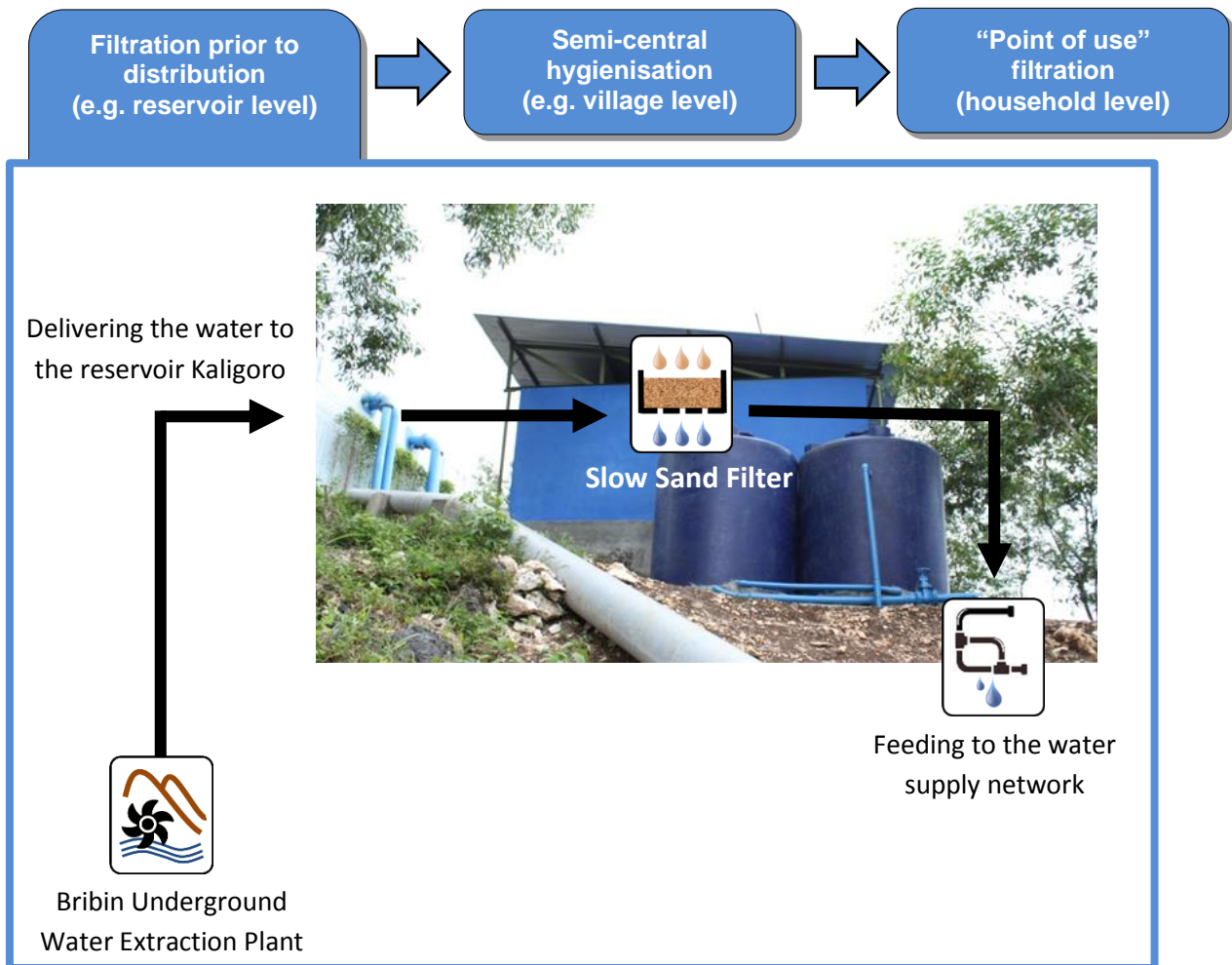


Fig. 1. Usage of a slow sand filter prior to the distribution

2 Implementation and Results

In cooperation with Indonesian partners, the first step of the water treatment concept was implemented exemplarily for one community directly supplied by the first reservoir fed by the underground supply plant Bribin, namely Kaligoro reservoir. To develop an optimized filter design, laboratory experiments with local sands were carried out. Four different types of sand had been investigated (see Tab. 1). As a result lava sand was selected which is not only effective for turbidity removal (82.09%) but also for the removal of total coliform (95.79 – 99.46 %) as well as E-coli (96.66 – 98.37 %).

Tab. 1 Type of filter medium and sand characteristics¹

Filter Medium	Effective grain size d_{10} (mm)	Uniformity coefficient C_u	Permeability (m/s)
Lava sand	0.25	3.06	3.09×10^{-4}
Beach sand	0.29	2.12	1.04×10^{-3}
Activated sand ^a	0.93	1.63	8.29×10^{-3}
Silica sand	1.03	1.88	5.47×10^{-3}

^aSilica sand coated with manganese oxides (e.g. $KMnO_4$)

For dimensioning of the plant, based on the assumption that approx. 195 m³/day of water need to be treated to supply the 5 sub-villages of the supply zone Kaligoro a total filter bed area of 50 m² was calculated. The preliminary design included 6 filter beds with a size of 25 m² each to allow an alternating operation. However, for the current exemplary implementation, only three filter beds were installed, which still allows a minor alternating operation, in order to validate their performance in field operation.

The developed filter concept differs from conventional slow sand filters regarding the following technical and operational features:

- Filters were built from locally available materials already tested at laboratory scale.
- Filters are operated intermittently, i.e. additional filter units are to be provided for alternated operation but securing uninterrupted supply.
- Filter units are covered to avoid algal growth which may cause oxygen depletion.
- Filter design is simple so that construction and operation is managed by local caretakers.

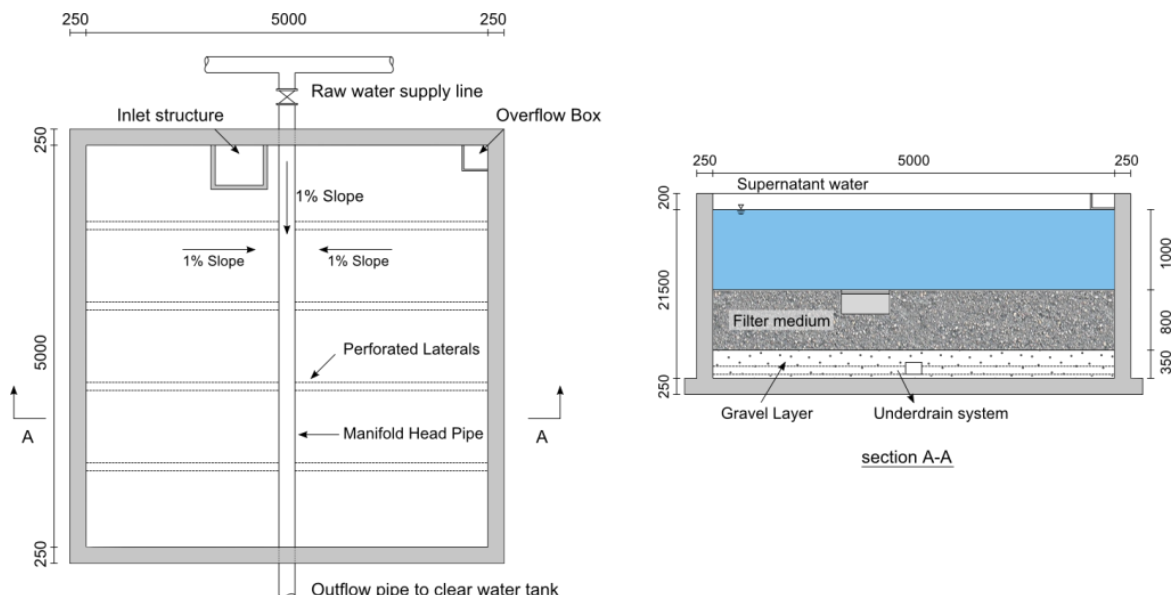


Fig.2 Layout of the slow sand filter (not to scale)

¹ Fuchs et. al. (2015): Planning and installation of a drinking water treatment in Gunung Kidul, Java, Indonesia. Water Science & Technology: Water Supply, 15.1.



Fig. 3. Location of the slow sand filter beside Kaligoro Reservoir (left), image of the construction phase (right)

3 Project Partners



KIT
Karlsruhe Institute of Technology



Ministry of Public Works and Public Housing



Province of Yogyakarta Special Region



batan
National Nuclear Energy Agency



Local Government of Gunung Kidul Regency

4 Contact

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