Available online at www.sciencedirect.com
ScienceDirect
ELSEVIER
Desalination 248 (2009) 91–98
DESALINATION
www.elsevier.com/locate/desal

Operational experience with a micro hydraulic mobile water treatment plant in Indonesia after the "Tsunami of 2004"

R. Garsadi[a*], H.T. Salim[a], I. Soekarno[a], A.F.J. Doppenberg[b], J.Q.J.C. Verberk[c]

[a]*Bandung Institute of Technology, LAPI ITB, Indonesia*
email: rusnandi@indosat.net.id
[b]*Vitens Evides International BV, Utrecht, The Netherlands*
[c]*Delft University of Technology, Faculty of Civil Engineering and Geosciences, Department of Watermanagement, Delft, The Netherlands*

Received 31 January 2008; revised accepted 15 May 2008

Abstract

In this paper, practical experiences of a mobile water treatment plant used for the first time in the aftermath of the 2004 Tsunami are discussed. The advantages of the mobile water treatment plant are its simple operation, and its low energy and chemical consumption. The operation of the device has been very successful. The installation has been used during several other natural disasters in Indonesia. Currently more than 30 installations are used on a daily basis in Indonesia.

Keywords: Disaster relief; Surface water treatment; Drinking water supply; Micro hydraulic mobile water treatment

1. Introduction

The provision of safe drinking water can become the source of major health concerns after a natural disaster. It is critical to have sufficient clean water available in the immediate aftermath of a disaster in order to treat the ill, provide for human consumption and maintain basic hygiene, support in the work of search and rescue, and to resume normal production and commercial activities. Access to water is a basic human right, implies a responsibility that goes beyond the protection of investments and life and is above all a responsibility of the government.

In disaster situations, the government is responsible not only for being prepared to effectively provide immediate assistance to disaster victims but also to maintain basic services following the disaster. A rapid and unplanned urban growth in many countries has increased the number of settlements on unstable, flood-prone, and high-risk land where phenomena such as landslides, rains, and earthquakes have devastating consequences. Millions of people are affected by

* Corresponding author.

Presented at the Water and Sanitation in International Development and Disaster Relief (WSIDDR) International Workshop Edinburgh, Scotland, UK, 28–30 May 2008.

0011-9164/09/$– See front matter
doi:10.1016/j.desal.2008.05.042

droughts, floods, tropical storms, earthquakes, forest fire and other disasters. Natural disaster can affect anyone in any place.

During the aftermath of a natural disaster it is of eminent importance to have a short response time in providing drinking water. Possibilities of producing drinking water are often very difficult, as the infrastructure is disrupted and public services are strained beyond their capacity. Possibilities of transportation and the availability of power supply and fuel are limited. The raw water is quite often very unstable, loaded with high turbidity, often up to 10,000 NTU, whereas technicians for operating treatment plants are difficult to find. Under these conditions high end technology – or conventional treatment plants do not perform as designed and fail in the long run.

In Indonesia, with a population of 220 million inhabitants, a micro hydraulic mobile water treatment plant (MHMWTP) has been developed by the Institute of Technology Bandung (LAPI ITB). This micro hydraulic mobile water treatment plant has a capacity of 400,000–500,000 L/day (15,000–20,000 L/h). The MHMWTP was for the first time used in the aftermath of the Tsunami of 2004 in Aceh. Currently more than 30 installations are in use by the Indonesian Army, the public work department, local governments and private companies. Furthermore, the Indonesian public work department is planning to prepare 10 locations of central disaster supporting facilities and 100 mobile micro hydraulic water treatment plants will be built. After the Tsunami in Aceh the MHMWTP has been an important asset in providing safe drinking water during 6 months. The produced drinking water was distributed by trucks and small distribution systems. Based on the experiences gained after the Tsunami of 2004–2005 a slightly modified mobile plant has effectively been used after the earth quake at Jogjakarta (2006) and the Tsunami in Pangandaran (2006, West Java), Jakarta big flooding February 2007 and South of Bandung. An important feature of the MHMWTP is that it can be operated by untrained personnel. The low energy and chemical consumption of the plant has tremendously eased the logistics for full continuous operation.

In order to permanently supply drinking water to small remote local communities a fixed plant with smaller capacities (3600–7200 L/h) based on the mobile plant is being constructed for daily water supply and also for anticipation of disaster around these remote communities.

The MHMWTP has been certificated by ministry of public work and Army of Indonesia and also a patent has been registered.

2. Process description

In conditions of a disaster clean water should be available in the disaster areas as soon as possible, preferably within 12 h after the disaster. The MHMWTP, as designed by ITB, is capable of treating raw waters with fluctuations in turbidity (up to a turbidity of 10,000 NTU) by a series of treatment processes all mounted on a truck. The processes are simple to operate stand alone as power supply is included in the mobile plant by a small generator (5 kW). The mobile plant needs only 1000–2000 W for power supply and has a clean water production capacity of 400 m^3/day.

The treatment process of the MHMWTP is similar to that of a conventional treatment process, i.e., hydraulic driven coagulation/flocculation, plate sedimentation, rapid filtration, optionally granular active carbon filtration and disinfection with chlorine solution (Fig. 1).

Water intake: Two submersible raw water pumps with capacity of 3 L/s, head of 8 m, wet cutter, water cooling. Pump supporting and mesh screen.

Booster pump: If the water level difference is more than 8 m between surface raw water and level of top the mobile installation or more than 20 m length intake to water treatment booster pumps can be added with capacity of 3 L/s and head of 8–12 m.

Centrifuge separators: The separation of discrete or heavy material and high turbidity is done by centrifuge hydraulic flow of three stage separation and energy and velocity come from recirculation centrifugal pump. Continuous flushing of concentrate sludge or discrete material is about 5% of the flow of raw water intake capacity.

Dosing system: The dosing system for injection of coagulant, pre disinfectant, pH correction is done by an negative pressure caused by the recirculation pump system. The dosage of every chemical can be adjusted.

Coagulation: The coagulation is mixed in 2 s with the raw water. The velocity gradient is about 1000 s^{-1}. The possible coagulants are Alum or Ferry Chloride with dosage of about 10–15 ppm.