

# SMALL WATER PURIFYING UNIT WITHOUT ELECTRIC POWER, FOR ISOLATED SMALL VILLAGES

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## Abstract

We had many calls from villages where clean and safe drinking waters are difficult to obtain, thus, especially children are being suffered from water borne diseases. As there were generally no available electrics, we designed a filtration unit (OngDalSaem, which means clean fountain in Korean), depending upon water qualities, with respect to arsenic and mercury levels, hardness, colloids and particles, and pathogens, to be operated without electric power. We installed either nanofiltration or microfiltration membranes as major filtration process, and also micro-filter for pretreatment. We have sent 10 units to various villages in different countries, including Kenya, South Sudan, Malawi, Mongol, Vietnam, Cambodia, and others, and also are planning to send 3~4 more this year. We also care about the maintenance and replacement of the filters and membranes, thus, have been working with volunteer works (normally priests and NGO members) for operating, maintenance, and replacements. We are also trying to transfer the technologies to make the system into the places where the OngDalSaem are set up. When we built the systems, we tried to do with some engineers and even normal residents in there so that they can easy maintain it and hopefully make one in near future. The volunteered operators and residents have been sending us the water samples periodically, thus, we could monitor the water qualities which were chosen depending on the site specifics, such as arsenic, hardness, mercury, and so on.

Keywords: Small filtration unit; OngDalSaem; Operation without electrics; Nanofiltration

## Introduction

In 2006, students of the GIST went to Cambodia to take samples for one of their projects, and witnessed bad environments of unsafe drinking water especially for children. When they came back, they conveyed wishes to us to send a water purifying unit, which was the start of the OngDalSaem project. Since then, we got requests from different countries to send the OngDalSaem unit. When we got the request, we analysed water qualities to properly design the unit, in terms of pre-treatment and major membrane types (i.e., either of NF or MF). The system has evolved in technologies, including hand-rotating high pressure pump, efficient cleaning protocols, different accommodating membrane modules, and etc. Even though our projects have financial limitations as there is no specific funding sources, but, faculties and students in GIST have been trying to make this project be continued, of our own tools and with minimum expenses.

## Methods

The small (OngDalSaem) system is comprised of a 5 to 20 micron cartridge micro-filter pretreatment unit which can be replaced easily with a different micro-filter rated at up to 200 microns, a hand-operated pump, and a major NF or MF membrane filtration unit. From our experience the pretreatment filter is generally replaced every 1–2 months, and the major membrane may be replaced every two years. Over 24 filters are normally supplied with the shipment of the unit. A pump was developed which uses a gears ratio (or chain) to make higher pump pressure using little manpower and can be operated even by children. We

can easily make 100 psi from the hand rotating pump. The OngDalSaem can be used for grey and even brackish water. With NF, OngDalSaem can produce 40 L within about 2 minutes, and with MF OngDalSaem can produce higher than 100L per minute. The NF OngDalSaem can be used to treat water with higher hardness, arsenic (especially arsenate), mercury, heavy metals, and many other toxic organics, such as endocrine disrupting chemicals and pesticides.

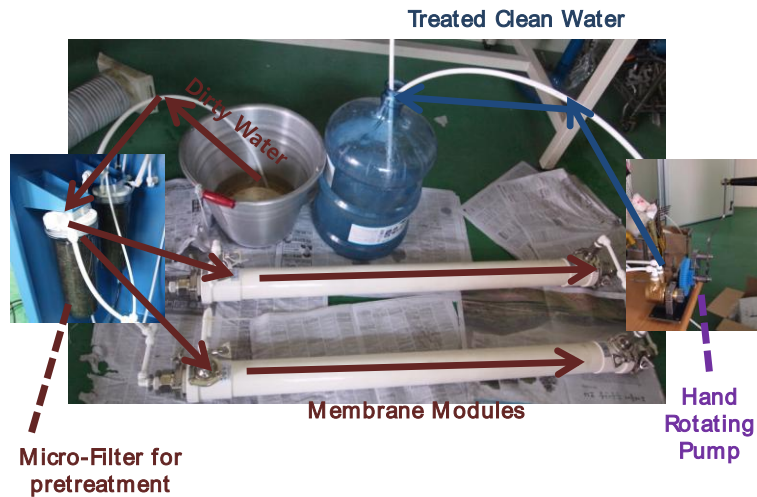


Figure 1. Schematics of the OngDalSaem unit.

## Results and discussion

During 2006~2010, we have provided the OngDalSaem to 12 different villages in 11 countries. As previously mentioned, we investigated the water qualities before we designed it, then, made and sent it to them (Table 1, Fig. 2). In this year of 2011, we have three more projects to send the OngDalSaem units to Mongol, Tanzania, and Eritrea. We do not believe this is end, but, we will do our best to renovate our system and continuously provide the units and maintain the efficiencies in the sites, with proper maintenances and replacements with helps of local village residents.

Table 1. List of the villages and countries which the OngDalSaem units were sent to.

Year	Countries, Villages	Membrane type of the unit and others
2006 (1)	Cambodia, Siemreap	Ultrafiltration, UV disinfection
2008 (2)	Kenya, Korr	NF
2009 (3)	South Sudan, Agangrial	NF; mercury removal
2010 (4)	Haiti, catastrophe area	NF
2010 (5)	Vietnam, Anjang province	Tight NF (~RO); arsenic removal
2010 (6)	Mongol, Darih	NF; hardness control
2010 (7)	Malawi	MF; pathogens removal
2010 (8)	Phillipines, Barangai	NF
2010 (9)	Zambia	MF
2010 (10)	Laos	Loose RO; arsenic removal
2010 (11)	Zambia, Meheba, Refugee camp	MF
2011 (12)	Indonesia, Muntawear island (Tsunami area)	MF



*Figure2. Photos from the villages with the OngDalSaem (from the left, Agangrial village in South Sudan, Darih village in Mongol, another Darih, and Malawi).*

## Conclusions

Last 6~7 years, we have been providing 12 of the small water purifying unit (named OngDalSaem) to the villages which deperately need safe drinking water, especially with children. Also, we have tried to properly maintain the units, in terms of pre-treatment and membrane replacements, with helps of priests, NGO volunteers, and residents. They gave us very precious feedbacks so that we can renovate our system. Even the unit can cover very small portions of the villages which need clean water, we want to trust this project can intiate both this type of technology development and propaganda of the water system for the people.