Surface Water Treatment in Palorinya Refugee Settlement, Uganda

Palorinya surface water treatment plant, Uganda - set-up, upgrades, operational guidance, lessons learnt and recommendations.

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This version was shortened from its original version in order to initiate a technical discussion with the supplier. It only contains what is relevant for this discussion.

1 Introduction

MSF has intervened recently in several contexts where large-scale surface water treatment has been a significant feature of the WatSan response – Gambella (Ethiopia), Central African Republic (CAR) and Bentiu (South Sudan) are some examples. The impact of these interventions has been significant. Surface water treatment, if feasible, has better potential for covering the needs of a population in the immediate phase of a response than groundwater. It is simpler, cheaper and, usually, does not involve contracting services beyond basic construction activities.

There are two important aspects to water supply interventions – the quantity and quality. Surface water treatment can deliver on both these to meet common guidelines and standards with relatively little fixed and running costs. This document details one surface water treatment plant (SWTP) intervention in Palorinya Refugee Settlement, Northern Uganda, in 2017 and serves several purposes:

- To be used as essential reading for any future surface water treatment intervention in the capacity of a technical brief,
- Bringing together all the experiences from the set-up, running and upgrade of the treatment plant, including the lessons learnt,
- Serving as a repository for all the documentation related to various aspects of the plant's operation - human resources, equipment, technical, siting, physical design and layout of the plant, and,
- Give concrete recommendations and follow-up points for future, similar interventions.

After MSF handed over the operation of the plant to the Ugandan Red Cross Society and withdrew from Palorinya in December 2017, the WatSan Unit in Amsterdam (MSF-OCA) engaged one of the project's WatSan managers (Fred Liesner) to collate all the documentation from the intervention and provide a structured background narrative to accompany it. The result is this comprehensive report, which serves as a technical reference and field guideline.

The experiences from Palorinya provided important lessons for MSF. We must capitalize on these experiences and further improve our tools, techniques and equipment to ensure that we can implement to the same scale in the future, even if the context and conditions might be different. There is no doubt that one of the most outstanding achievements of this project, beyond delivering over 400 million litres of water to a refugee population (enough for, on average, the needs of 55-60,000 people a day at 20L/person/day), was the development of the staff's capacity to run, maintain and develop the site to a consistently high quality.

Achieving the standards for quantity and quality of supplied water played a big role in the intervention in Palorinya. There are still many technical improvements to be made to MSF's approach to this scale

of surface water treatment and it is hoped that this document serves to highlight the areas that need further research and investigation so we can continue to improve in this field.

Matt Arnold, Water and Sanitation Advisor, MSF-OCA, Amsterdam, March 2018.

2 Key Recommendations

Following the experiences in Palorinya and other MSF interventions, these key recommendations are made:

1. This and several other interventions involving surface water treatment plants (SWTPs) reinforce the need to **maintain both a central emergency stock (CES) of materials and the in-house expertise** to use these items to this scale.
2. **Standard designs/layouts for large scale SWTPs,** with a variety of capacities, were developed in Palorinya - these can serve as models for future SWTP interventions.
3. Developing a site with a view to **longer-term use** is important. SWTPs are rarely a short-term or interim solution to water supply.
4. The **management and monitoring** documents used in Palorinya offer **templates** that can be used or adapted for other, similar interventions. Most of these documents are embedded in this report.
5. Rationalising the operation of the plant and upgrading to a more sustainable operational model saves significant running costs – primarily in HR and fuel.
6. The contents of the **MSF kits should be optimized for their intended use** as opposed to being optimized solely for logistical or financial reasons. Some major quality issues became apparent in Palorinya and some of which are already well known to MSF WatSans. Proposed improvements and adaptations to current kits or equipment need to be presented to the WatSan Working Group (WWG) and suppliers.
7. **All SWTPs should include water quality laboratory testing capacity** to monitor the bacteriological and inorganic chemical water quality (CWQ) and processes at the plant. In addition to basic WQ parameters MSF should continue to **research and assess the production of Disinfection By-Products (DBPs) at SWTPs.**
8. **Bacteriological testing at different stages of an SWTP's operation should become routine.** A kit should include both the Compact Dry® EC[1] as a direct enumeration (DE) method and Compartment Bag Test[2] kits as a most probable number (MPN) method – the former being a more comprehensive enumeration method and the latter being easier to handle and use in the field.
9. **Systematic daily follow up of chlorinated water supply at distribution points** is critical for optimising treatment at the SWTP in order to meet chlorination standards up to the household level.

[1] As supplied by HyServe, see; https://hyserve.com/produkt.php?lang=en&gr=1&pr=13
[2] As supplied by Aquagenx, see; https://www.aquagenx.com/

10. Water trucking operations pose many challenges. Good monitoring, record keeping, and reporting helps to lobby other agencies who contract and manage trucking activities.
11. Improvement of surface water treatment processes within MSF necessitates **exploring the following:**
    - Adapting methods to **reduce residual metal concentrations** in finished water,
    - Optimising the process of rapid chemical dosing and mixing,
    - Optimising the flocculation process through **improved sedimentation tank design**,
    - Assess the feasibility of using polyelectrolytes or **other flocculant aids** to reduce consumption of primary coagulants, improve overall plant efficiency and reduce residual treatment chemicals in the finished water,
    - Designing a 'constant flow' flocculation system for emergencies, similar in principle to the up-flow clarifier developed by Oxfam[13],
    - Establishing the best and most responsible method to treat and **dispose of sludge**, and,
    - Better quantification of precursors that are a risk to produce disinfection by-products formation and the development of best practice guidance in this regard.
12. Handovers are facilitated by **proper quantification of the full running costs of the site** as this will influence the decision of other actors to take over and commit to the costs themselves.
13. **Health and fire safety** are important in all WatSan interventions. Solid training programmes should be developed with staff and proper enforcement of rules implemented.

- Pump curves must be consulted to ensure pumps are used at an efficient duty point.
- An arch type or steel pipe truck filling gantry should be designed and tested.
- Spiral hose must be used to connect suction lines to T45s to reduce vibration on the tank - these lengths should then be covered in pieces of lay-flat hose.
- The Robin SE 80XD is a reliable pump but they must be bolted to a concrete plinth for longer term operation to reduce vibration induced damage.
- Floc-proof suction chambers (FPSCs) and a good flushing/washout procedure can be used to remove water from a sedimentation tank without pumping flocs.
- An extra flange should be supplied with the T-tank kits. This would allow teams in the field to fit a drain in the base of the tank. Butyl Group should be contacted to ensure that the installation of a flange on the floor of the tank will not compromise the integrity of the tank lining.

2.1.1 KWATKTANF30 – 30m^3 metal frame tank

No.	ISSUES	RECOMMENDATIONS
1	After less than three months of service there were several welds cracking on the upright columns of the frame. These were from Labaronne-Citaf company.  *Photo 1: Detail of repair to 30m^3 metal frame tank upright*  *Photo 2: Detail of repair to 30m^3 metal frame tank upright*  *Photo 3: Locally completed welds on 30m^3 metal frame tank uprights*	This only happened on the model that made use of one-piece uprights, not the version with the uprights in 3 sections. Improve build quality with better quality welding and material selection. Note that the team also received some of the kits (Labaronne-Citaf) with welds missing on the vertical posts; these were rewelded in the field at a local metal shop. The workmanship of these items is poor. The tool kit includes a file for the removal of burred edges left on vertical post unions. Labaronne-Citaf need to follow-up on quality control in their factories.

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2	Top-sheet cover catches rainwater and bulges into the water.	Increase diameter of top sheet to allow for a slope and provide a central column, cross beams or float. Use rope instead of elastic to attach the top sheet to the tank. Alternatively remove the top sheet from the kit.
3	No way to investigate yellow metal-frame tanks without a ladder or raised platform to observe flocculation process as they are too high.	Return to the old dimensions and design as provided by PRONAL[3] 'white tanks' in the past.
4	Flocculation takes longer in the yellow frame tanks compared with white (PRONAL) tanks.	Ditto.

[3] See; https://www.pronal.com/english/