BIOPOWER CORPORATION

for consideration to

basic education
Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF BASIC EDUCATION

BIOLOGICAL WASTEWATER TREATMENT PLANTS FOR RURAL- AND PERI-URBAN SCHOOLS

MARCH 2021

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MARCH 2021

Designed by BioPower Corporation

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TABLE OF CONTENTS

1. INTRODUCTION

In response to the announcement of the Sanitation Appropriate for Education (SAFE) Initiative as outlined during the presidential breakfast on 14 August 2018 by President Ramaphosa, **BioPower KZN** through **BioPower Corporation** (hereby noted as **BioPower**), prepared a proposal on solutions on offer for improved sanitation at schools with substandard sanitation. This proposal is a continuation of the work that was done leading up to this date.

2. PROBLEM STATEMENT

After the SAFE initiative announcement following the tragic and unfortunate loss of 5-year old Lumka Mketwa in a pit latrine at Luna Primary School Bizana, BioPower prepared a proposal on possible solutions to convert VIP/pit latrines and septic tanks at schools nationwide to flushing toilets. This addresses not only the safety and health of learners but also their dignity, and cost savings by the Department and individual institutions.

The Department of Basic Education currently spend millions of rands per annum on the desludging of school VIP/pit latrines at a cost of roughly R 1.65 (excl. VAT) per litre.

These sanitation systems get emptied by Vacuum Trucks, with the following potential risks associated with this process:

- Possibility of illegal dumping into rivers and streams;
- Possibility of spillage;
- Putting additional strain on Wastewater Treatment Works (WWTW) due to capacity and the use of harsh chemicals in these pit latrines/septic tanks;
- Health risks associated with the above factors;
- Environmental risks associated with the above factors.

When studying the below table regarding Intestinal Infectious Disease fatalities in South Africa (especially troublesome in children from 0-14 years old) it can be concluded that sub-standard sanitation facilities and wastewater effluent plays a big part in this worrying statistic. Most of these fatalities are due to waterborne diseases.

Extracted from The Ten Leading Underlying Natural Causes by Age and Sex 2015		
Intestinal Infectious Diseases mortality (STATSSA 2015)		
Gender and Age	**Cases of Death**	**Percentage**
Both Sexes, ages 0-14	3 536 out of 38 254	9.2% (Ranked 1st)
Both Sexes, ages 15-49	2 037 out of 131 593	1.5% (Ranked 7th)

The SAFE Initiative Audit focused on the following subpar sanitation facilities at schools:

- Schools without sanitation;
- Schools with pit toilets;
- Schools provided with sanitation but pit toilets not demolished;
- Sanitation not fit for purpose (age appropriate);
- Schools with insufficient sanitation.

The following figures were made available across provinces:

	SCHOOLS	
PROVINCE	**PIT LATRINES ONLY AND UNACCEPTABLE SANITATION**	**OTHER INSUFFICIENT SANITATION**
Eastern Cape	1 598	216
Free State	156	40
Gauteng	0	435
KwaZulu-Natal	1 365	59
Limpopo	507	614
Mpumalanga	127	206
North West	145	119
Northern Cape	0	240
Western Cape	0	174
TOTAL	**3 898**	**2 103**

3. SCOPE OF WORK

Keeping in mind the identified problem-areas highlighted in ***Section 2,*** the following critical areas will be addressed by the proposal:

- Ensuring the safety and health-profile of every learner in rural schools that currently must use pit facilities.
- Conversion of VIP/pit latrine systems to flushing toilets linked to a DEWATS system.
- Cost saving for the Department of Basic Education and other governmental entities.
- Preserving precious underground water resources through treatment and containment; and
- Eradicating the illegal dumping of faecal sludge into the rivers and streams.

4. PROPOSAL DETAILS: FLUSH-TECH SANITATION SYSTEM

Flush-Tech Sanitation System Biological Wastewater Treatment Plants should be installed to cater for the inflow from the identified schools. This serves as a natural progression from the pit latrines/septic tanks currently used in the education system for rural schools.

What is the Flush-Tech Sanitation System?

The **Flush-Tech Sanitation System (FTS)** solution is based on the Sequencing Batch Reactor (SBR) principle in conjunction with the biological product BioSol SL36.

The system consists of a tank system divided in an anaerobic, anoxic and aerobic chamber. The entire system is fully automatic and is calibrated to operate for a specific HRT depending on the organic load rate present.

An inlet screen is fitted in the Inlet Work which removes large solids e.g. plastic packets etc. which needs to be manually cleaned daily and disposed of.

To ensure that the Primary Tanks (Sludge Storage Tanks) never needs to be desludged, the BioSol SL36 is added to ensure that a microbiological ecosystem is established, and the correct bacterial levels within the system maintained.

The system is designed specifically for rural applications where there is no access - or limited access - to sewage treatment and can replace e.g., VIP toilets, pit latrines, chemical toilets, etc. Typical applications include schools, RDP housing and informal settlements.

Wastewater gets treated and recycled to flush the toilets and/or for gardening or irrigation purposes, saving up to 60% of freshwater.

Job creation involves appointing people from the community during the construction phase of the project, with skills development involved. Furthermore, a permanent caretaker will be appointed from the community.

The FTS is custom designed for any sector application or area and combine the best elements of anaerobic and aerobic digestion to provide superior wastewater treatment. The system readily and consistently meets the secondary treatment standards of COD, BOD and mg/L TSS as required by the Department of Water and Sanitation (DWS).

The system:

- Through freshwater savings of up to 60%, the FTS can pay itself off in roughly 3 years.
- Is fully automated but can be remotely adjusted/operated from anywhere in the world with web-based functionality (computer and cellphone) Troubleshooting can similarly be done.
- Has a state-of-the-art surveillance camera system which together with the online processor function can immediately indicate the state of the system.
- Dedicated pH, Dissolved Oxygen and MLSS probes will be installed for real-time water quality monitoring.

Benefits include:

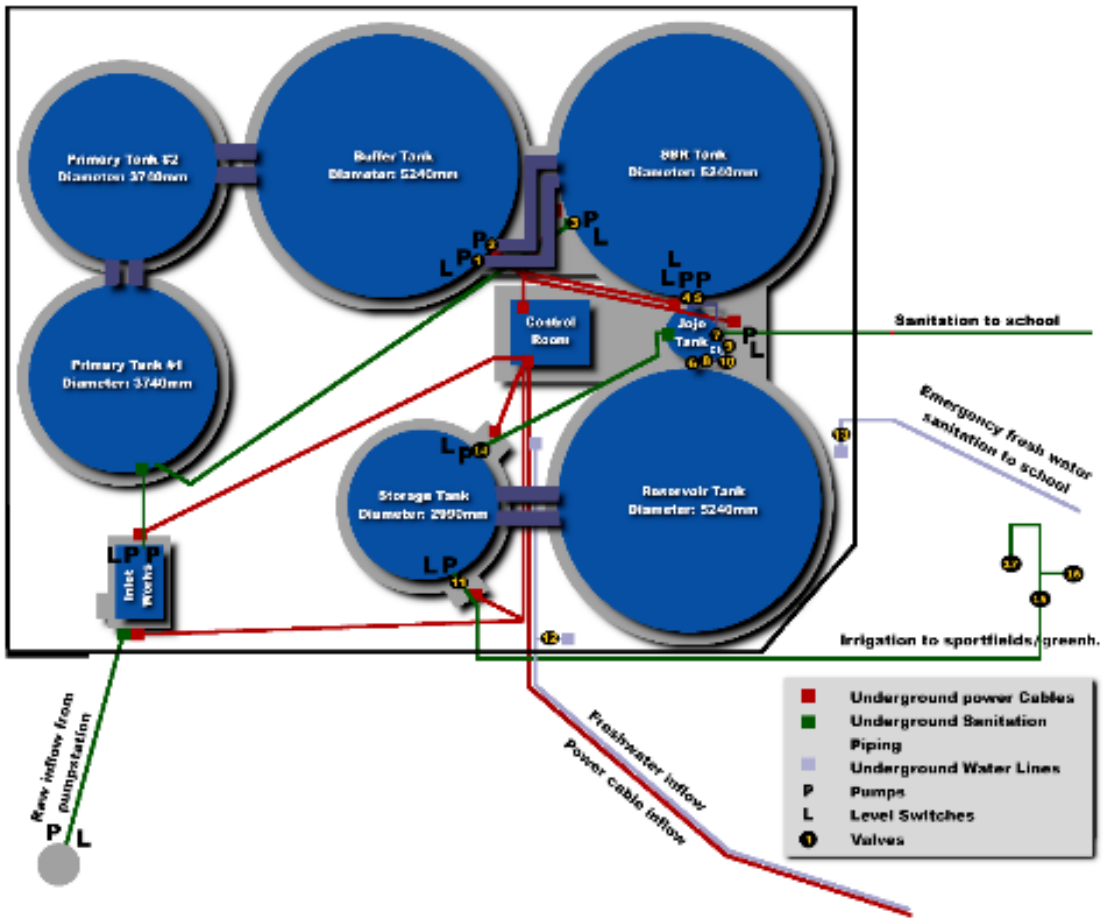
- Improved sanitation facilities with flushing toilets.
- Improved dignity of learners and educators.
- Improved safety, health and hygiene for learners and educators.
- The eradication of expensive stop-gap measures to deal with schools sanitation.
- Saving up to 60% of potable water.
- Direct cost saving for the Department of Basic Education; and
- Direct health benefits for the communities in the area.

The following aims will be addressed by the Flush-Tech Sanitation System project proposal:

i. The construction, installation and commission of a new Flush-Tech Sanitation System DEWATS system at identified schools countrywide.
ii. The ensured compliance of effluent with regards to microbiological-, chemical- and physical effluent standards as dictated by the Department of Water and Sanitation.
iii. Assistance to the Department of Basic Education with regards to managerial reporting, wastewater testing and the timeous submission of these results (as per negotiated maintenance plan detail).
iv. Improve the socio-economic circumstances of the beneficiary communities through the creation of jobs during the implementation of the project. Where feasible, local materials and labour would be utilised.
v. Improvement of general health and hygiene through the proper treatment of the sewage before it enters the environment.

This system has already been demonstrated in a school environment, more specifically at Tinley Manor Primary School in KwaZulu-Natal – where it caters for more than 1,200 learners to great aplomb.

4.1. Typical FTS Installation for Schools: Tinley Manor Primary School



4.1.1 Pump Station and Inlet Works

The pump station is the first receiver of sludge from the school toilets and level switches control the managed pumping of influent into the inlet works.

The inlet works receive sludge from the pump station, where it is screened from foreign materials by the screen installed. This is cleaned by the plant operator daily and the debris is disposed of.

4.1.2 Primary Tanks and Buffer

The Primary Settlement tanks are fed from the inlet works, where all sludge either settle or float. The mid-level connection between the primaries isolates the solids for BioSol SL36 biological action.

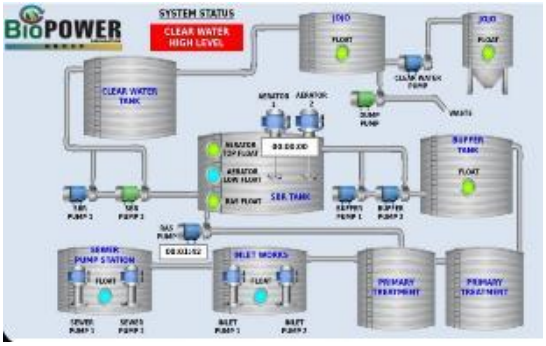
From the second Primary Tank to the buffer are top flowing connections to en-sure treated greywater with minimal suspended solids. It is stored in the buffer before loading the SBR.

4.1.3 Control Room

The Control Room contains the electrical box, Processor, Wi-Fi and camera equipment. The plant can be controlled from the room and is secured through an alarm system that alerts offsite response.

4.1.4 Processor and Operation

The Processor hosts a touchscreen interface for manually controlling the pumps and aerators that govern the plant. This is an automatic process but can be overridden.



The same interface as at the plant is also available on the phones and laptops of key BioPower personnel – meaning the plant can be manually adjusted and monitored from anywhere in the world as the need arises.

4.1.5 SBR Tank and Aeration

The SBR tank is aerated by two BioCore SL10 jet mixers that are designed & built by BioPower.

The Jetmixers are driven by two 2.2kW air compressors kept in a strong room and secured by sensors linked to the alarm system.

The vortex created by the specialised equipment mix and aerates the SBR for optimal biochemical action

The BioCore SL10 jet mixers were designed to be no-maintenance systems, with the air compressors being easily replaceable should there be any failure. The processor will alert the company in this event.

4.1.6 Chlorination

An inline chlorinator doses the flow from the SBR-tank with Calcium Hypochlorite. This is much safer and environmentally friendly than the normal chlorine generally used. The cartridges get replaced after depletion and ensure that any remaining bacteria (including that from the BioSol SL36 biological additive used) before the recycled water is used for flushing or irrigation.

4.1.7 Reservoir-, Storage- and JoJo Tanks

The reservoir-, storage- and JoJo tanks receive the final effluent from the SBR and chlorination units, whereafter it is ready for reuse.

The volumes of usable effluent exceed the needs of the toilets and allow that the greenhouse and future sports fields can be serviced.

4.1.8 Piping and Pumps

Piping was done overland and underground as needed. All overland pipes are inside the plant which is secured. This leaves no exposed greywater piping on the school ground. Valves are all numbered for easy maintenance and QC.


4.1.9 Plant Security

Clear-vu fencing with razor wire on top secure the site.

Furthermore, all pumps and equipment are locked up behind steel bars or with chains and padlocks secured to rawl bolts in the concrete.

There are two beams, and two optic sensors that trigger an alarm linked to offsite security.

Security/monitoring cameras also show live footage of the plant.



4.1.10 Surveillance Cameras

Cameras have been installed in the plant at strategic points with one-month footage back-up. This ensures security AND monitoring at any time.

4.1.11 Greenhouse

The greenhouse (dubbed Ingwenya Greenhouse) was installed to use the excess greywater for irrigation. The released greywater complies with regulations.

Vegetables for the learners will be grown here without the need for municipal water.

4.2. Process Description

a). Biological Wastewater Treatment Plants (such as the FTS) are installed at the lowest point/s in the community/facility, and wastewater is gravity-fed/pumped from the ablution facilities/houses. The system is installed above-ground, with a minimal amount of cutting into the soil.

b). From the Inlet Works, influent flows to the Primary Tanks connected in series.

c). After the Primary Tanks, the wastewater flows into the Buffer Tank, before loading into the SBR Tanks.

d). In the SBR Tank, aeration takes place from two (2) compressors installed behind a steel door that feed two (2) BioCore SL10 Jet Mixers suspended in the tank.

e). Sludge from the SBR Tank is pumped back to the Primary Tank with a RAS pump.

f). Between the SBR- and Reservoir Tank the treated wastewater passes an inline Low-Pressure Chlorine Dosing unit for final disinfection.

g). Sequencing Batch Reactor (SBR) principles, BioSol SL36 biological additive and a Calcium Hypochlorite in-line dosing unit ensures compliance to General Releasing Standards as per Section 39 of the National Water Act, 1998 (Act No. 36 of 1998).

h). Biological Wastewater Treatment Plants can be modularly expanded to a larger size should such expansion be required at a later stage.

4.3. Effluent Compliance

The FTS system ensures that compliance with the General Releasing Standards as per Section 39 of the National Water Act, 1998 (Act No. 36 of 1998) is reached:

a). The Sequencing Batch Reactor method ensures through aeration that sufficient nitrification and denitrification takes place to break down ammonia/ammonium and nitrite/nitrates in the wastewater, as well as the treatment of phosphates and other potentially harmful chemicals.

b). By using a RAS pump, activated sludge is reintroduced in the Primary Tanks, ensuring efficient inoculation of the bacterial ecosystem.

c). Using the BioSol SL36 biological additive ensures the elimination of solids in the FTS and prevents coliforms (as expressed in wastewater samples as Total Coliforms, Faecal Coliforms and E.coli) from dominating the system, keeping them well within prescribed limits.

d). Through the use of inline Calcium Hypochlorite into the final effluent, **BioPower ensures that no bacteria that can harm communities- or the environment in the area get released in any application.**

e). Continuous QA and QC include effluent sample testing, and during the first three (3) months, careful monitoring will allow small adjustments to be made to the operation of the FTS system, the dosage of BioSol SL36, as well as the application of Calcium Hypochlorite. This ensures that an optimally adjusted FTS system will release the best quality effluent.

f). The Water Research Commission (WRC) compiled a Sanitation Challenge report as tasked by the Department of Water and Sanitation. This was to execute sanitation challenge (SanIC) aims to provide a vehicle for technical evaluation and demonstration of appropriate sanitation technologies by bridging the knowledge

gap on the functionality of novel sanitation solutions, and the appraisal of design quality of these solutions.

g).

h). The outcomes of these evaluations will be used to provide recommendations to national and local government on the appropriateness and effectiveness of the assessed technologies. Below find an abstracted table from the WRC / SanIC document.

Technology	Brief Description	Av. Score (10)	Advantages	Concerns	Where can it be applied	Recommendation
Flush Tech	**An alternative to VIP**	**8,5***	**Affordability, maintenance & space requirement**	**Waste is treated in the system, water is recovered & recycled for flushing**	**Urban, peri-urban and rural schools**	**Need to train people in use and maintenance**

High priority technologies received average Expert Panel review scores of 7 out of 10 and above.

i). Treated and compliant effluent is discharged at three (3) points, namely:

- School ablution blocks.
- Greenhouse.
- Sports Fields.

j). Although wastewater often appears to be of acceptable quality according to the National Water Act, there could still be pollution present in the final effluent. Only by taking regular samples, the real quality of the final effluent could be determined.

k). It will also provide a good indication whether the FTS is performing according to the design capacity and if any build-up of sludge has occurred over time that decreases the retention time of the FTS system that results in a poor quality of effluent. Analyses such as COD, TSS, pH, EC, BOD, E.Coli, etc. that the National Water Act required, are indicators of a change in the FTS system.

l). Analyses of effluent provide the acceptable pollutant limits, but also if the results are above the set limits. Any accredited laboratory will provide the minimum acceptable limits for the different analyses requested. The laboratory will also provide the applicable analyses to be done for the quality of final effluent.

National approved releasing limits according to the National Water Act is as follows:

SAMPLE	RELEASE LIMIT	NOTES
Ammonia (Nitrogen) mg/l	<6	
Chemical Oxygen Demand (COD) mg/l	<75	
Total Suspended Solids (TSS) mg/l	<25	
E.coli (count per 100ml)	<1 000	
Faecal Coliforms (FC) count per 100ml	<1 000	
Total Coliforms (TC) count per 100ml	<1 000	
Electrical Conductivity (EC) Ms/m	<70	Lower release limit
	<150	Upper release limit
pH (pH units)	<5.5	Lower release limit
	<9.5	Upper release limit

4.4. Inclusions, Exclusions and Requirements

The proposal includes:

- All mechanical equipment, security fence and chlorination unit.
- All earthworks.
- All concrete tanks and works.
- All onsite labour requirements.
- Medicals for 8-person workforce.
- Standard Operating Procedure to be supplied at handover.
- Guarantee as stipulated at ***Section 4.7***.

The following is not included in the project, and is a requirement for the installation of the system where stipulated:

- The supply with electricity at the Flush-Tech Sanitation System site – a 380V installation (requirement).
- The installation of a sewer lines from the schools to the Flush-Tech Sanitation System site (requirement).
- The supply and installation of a surge protection system for the mechanical- and electrical systems (requirement for guarantee).
- The supply and installation of a floodlight system for night-time.
- The appointment of a caretaker that does general housekeeping and maintenance on the Flush-Tech Sanitation System site. He will receive basic training, and his daily duties would include raking the manual inlet screen and disposing of the screenings (requirement).

4.5. Maintenance

Monthly maintenance costs (to be negotiated) would include the following:

- ***BioSol SL36 and Calcium Hypochlorite:*** The recommended dosage of BioSol SL36 is dependent on the size of the system but will be divided equally among the toilets in use and flushed down on Mondays and Fridays.
- **Inspection:** Every two (2) months a technician would do a thorough inspection onsite, where all the equipment would be checked. A test sample of the effluent would also be taken and given in for analysis to monitor the efficiency of the system, as well as a sludge test. These results would be made available to the department.
- **GSM SMS-Modem:** An SMS-modem would be connected to the control panel, and inform the technician, and project manager of any equipment failures, or power cuts the moment they occur for swift attendance.

4.6. Local Content

The Flush-Tech Sanitation System contains the following:

Component	Availability
Construction Material	Municipal where possible
Pumps	National (provincial if feasible)
Galvanised Steel tanks and liners	National
Internet Capable Processor	National
Pipes and fittings	Municipal where possible
Aerators systems	National
Fencing	Provincial
Other technical Equipment	National

The FTS system is 100% proudly local South African content, and wherever possible – materials, labour and pumps are first sourced in the ward, municipality or province. If this is not feasible due to supply and/or costing – it will be sourced nationally at our trusted suppliers.

All labour (except certain skilled individuals in the employ of BioPower) is sourced from the local community through consultation with the CLO/counsellor.

4.7. Terms of Warranty—One Year

This Warranty, as well as the statute of limitations for any claim of damages for defective work or materials, is one year from substantial completion, defined as the date of commissioning the DEWATS system. If Contractor performs warranty work within this period, this warranty shall be extended to the repaired or replaced work itself and be covered for one year after completion, as to that specific work.

4.8. Transferability

This warranty applies to the original owner and may be transferred to any subsequent owner within the initial one-year period after handover.

4.9. Payment Conditions

- BPC quotations are valid for a period of thirty (30) days from the final quotation documented date while stocks at current prices last.
- Prices are subject to fluctuations in currency exchange rates at the time of importation and this risk is borne by the customer.
- All goods remain the property of BPC until paid in full. BPC does not warranty any work carried out by outside installers whatsoever.
- Delivery is a minimum of 6 to 8 weeks (within RSA-delivery time may differ to countries outside RSA);
- All payment conditions will be negotiated and agreed upon before the start of the project.

4.10. Completion Times

Manufacturing time is usually approximately 4-6 weeks from:

- Receipt of signed order confirmation.
- Accompanying contractual documentation.
- The necessary payment(s).

4.11. What Is Covered

4.11.1. Wet- and Concrete Work

- Galvanised construction dams/concrete tanks.
- Security fence (where applicable).
- Foundations and slabs.
- Roof (where applicable).
- Plumbing work.

4.11.2. Materials and Equipment

- Liners as specified (where applicable).
- Electrical work (Certificate of Compliance will be issued).
- Mechanical work.
- Other hot-tip galvanised materials.

BioPower will issue an official company guarantee for the process and ensure that a qualified Civil Engineer will be appointed. This individual will have the appropriate appointment- and assurance certificate to validate the design and construction.

4.12. What Is Not Covered

This limited warranty does not cover the following items:

1. Damage or defects caused by the failure to maintain any item or keep it in good working order.
2. Damage resulting from fire, freezing, storms, electrical malfunction or surge, lightening, earthquake, pest damage, acts of God, or other unforeseen causes or accidents.
3. Damage from alterations, misuse, theft, or abuse by any person; ordinary wear and tear; or problems caused by lack of maintenance.
4. Damage resulting from your failure to observe any operation instructions furnished at the time of installation.
5. Any item furnished, installed, modified, altered, or repaired by you or any other person other than Contractor.
6. Exact duplication in matching, texture, and colour cannot be guaranteed. Variations within industry tolerances will be considered.

4.13. Complete Agreement

This warranty constitutes the entire integrated agreement and understanding of the parties as to any causes of action for losses, expenses, or damages under warranty, workmanship, or construction material/ product defect issues, and supersedes as well as pre-empts any oral statements or representations by Contractor or its agents.

The compliance guaranteed is solely dependent on the use of BioSol SL36 and Chlorine as specified by BioPower. Any deviations from the prescribed dosages would render the compliance guarantee null and void.

5. IMPLEMENTATION OF INTERIM MEASURES

5.1. Treatment of Pit Latrines/Septic Tanks in Schools

The identified schools that have sanitation facilities comprised of VIP- or traditional pit latrines or septic tanks can be treated for the interim period with BioSol SL36 as follows:

1. The principal or appointed school official will identify an assistant to help with the weekly treatment of sanitation facilities.
2. The principal/appointed official and assistant will be given training and Personal Protective Equipment (PPE) by BioPower to successfully fulfil their duties during treatment.
3. The school treatment procedure will be demonstrated during BioPower training.
4. The school treatment process will officially be handed over to the designated official and assistant.
5. Telephonic support will be available to the school officials regarding troubleshooting any obstacles that could hamper the pit latrine/septic tank treatment programme.
6. A dedicated BioPower Quality Control and Monitoring Group (QCM) will visit each school every second month and perform measurements on the success of the programme – this will be reported on in a summary of the results from the schools treated.
7. Sufficient BioSol SL36 will be available to the identified schools at all times.

5.2. Personal Protective Equipment (PPE) and Tools

The following start-up PPE for the project will be supplied:

- Overalls
- Gloves
- Masks
- Backpack Spray
- Watering can

5.3. Training Programme and Rollout

BioPower will rollout training and product to schools in need of interim solutions until such time as a Biological Wastewater Treatment Plant can be installed. Thereafter QCM will visit the schools every second month to assist the officials with any issues experienced and also measure the sludge levels and monitor odour aesthetics at each school. Furthermore, telephonic assistance and referral will be available to all officials regarding their sanitation system.

The abovementioned interim treatment programme will supply a healthy and hygienic school environment until the implementation of all Flush-Tech Sanitation Systems have been completed.

6. BIOPOWER CORPORATION AND TECHNOLOGIES

BioPower Corporation's main business is wastewater management, civil works, consulting, construction, and renewable energy - and work to the highest ethical and quality standards with care to the green and construction environment. Each situation for BioPower is unique and specific designs and specific products are implemented to overcome specific problems.

Over and above the technical abilities and professional capabilities, BioPower also believes their unique products, the Flush-Tech Sanitation System and BioSol SL36, is the solution to all the challenges as discussed. As described in detail above, these products are what BioPower uses to treat and enhance pit latrine systems, septic tank systems, Wastewater Treatment Works (WWTW), Waste Stabilisation Ponds (WSP) as well as the Flush-Tech Sanitation System itself.

The BioPower Team consists of the following competent professionals who will make an impact on the proposed project:

- Biochemical engineers.
- Researchers.
- Microbiologists with active research teams who operate in this specialised market.
- Training specialists to provide effective training to small enterprises that will be established as part of the implementation plan.
- Accountants, Auditors and Corporate Governance specialists.
- Managers and quality controllers who will ensure proper standards and controls are adhered to in this highly sensitive market.
- Managers who understand the programme of action and priority needs on district and local levels of government.

6.1. Flush-Tech Sanitation System

The Flush Tech Sanitation System (FTS) solution is based on the Sequence Batch Reactor (SBR) principle in conjunction with the bio product BioSol SL36.

The system consists of a Tank (system) divided in an anaerobic, anoxic and aerobic chamber. The entire system is fully automatic and is calibrated to operate for a specific HRT of a few hours depending on the organic load rate present. An inlet screen is fitted which removes large solids e.g., disposable nappies etc. which needs to be cleaned

daily (manually or automatically) and disposed of. To ensure that the sludge storage tank never needs to be emptied, a biological product called BioSol SL36 is added to ensure that the correct bacterial levels within the system is maintained.

The system is designed for rural applications where there is no access to sewerage treatment and can replace e.g., pit latrines, chemical toilets, etc. where possible. Typical applications include schools, RDP housing estates as well as informal settlements and total Communities.

Wastewater gets treated and recycled to flush the toilets and/or for gardening or irrigation purposes, saving up to 50% of wastewater.

Job creation also involves appointing people responsible for cleaning the inlet screen and disposing of the debris.

The FTS can be designed to accommodate several houses up to communities with a single Unit.

The FTS (various sizes available) combine the best elements of anaerobic and aerobic digestion to provide superior wastewater treatment. The system readily and consistently meets the secondary treatment standards of COD, BOD and mg/L TSS as required by the Department of Water and Sanitation (DWS).

The Work Research Council (WRC) compiled a Sanitation Challenge report as tasked by the Department of Water and Sanitation. This was to execute sanitation challenge (SanIC) aims to provide a vehicle for technical evaluation and demonstration of appropriate sanitation technologies by bridging the knowledge gap on the functionality of novel sanitation solutions, and the appraisal of design quality of these solutions.

The outcomes of these evaluations will be used to provide recommendations to national and local government on the appropriateness and effectiveness of the assessed technologies. Below find an abstracted table from the WRC / SanIC document.

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Flush Tech	**An alternative to VIP**	**8,5***	**Affordability, maintenance & space requirement**	**Waste is treated in the system, water is recovered & recycled for flushing**	**Urban, peri-urban and rural schools**	**Need to train people in use and maintenance**

High priority sanitation technologies receiving average Expert Panel review scores of 7 out of 10 and above.

6.1.1. Functional description Flush-Tech Sanitation System

The wastewater treatment plant operates in accordance with the activated sludge process with retention (single tank or SBR plant).

Following preliminary treatment, the wastewater is buffered in the coarse trap and treated in the SBR in batches. With this, the treatment process runs with denitrification, nitrification, settling phase, clarified water removal and removal of excess sludge separated from each other by time. No spatial separation for the individual process steps is necessary.

Variations in inflow are buffered and thus have no influence on the treatment performance.

In detail, with the Flush-Tech Sanitation System, the following stages are differentiated:

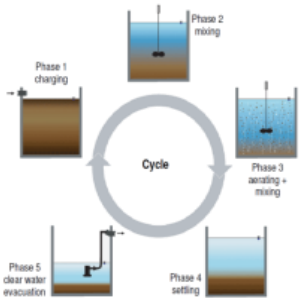
1. *Coarse trap / sludge storage*
    - Here primary and secondary sludge is retained and/or stored.
    - With this the excess sludge storage can also be a separate tank.
2. *Buffer tank*
    - For the deliberate charging of the SBR tank and intermediate storage of the wastewater with larger surges in loading and as bridging the phase in which the SB reactor can't receive. Submersible motor pump(s) for the charging and level switch for the process cycle and protection of the pump(s).
3. *SBR tank (retention tank)*
    - The actual biological treatment stage with clarified water removal, aerator/mixer mounted on floats and excess sludge recirculation via submersible pump

6.1.2. Operating Manual

We designate the time interval which is necessary for the filling, the biological process and the separation of the activated sludge from the treated water as well as the extraction of the clarified water and of the excess sludge, as a cycle. The Flush-Tech Sanitation System, according to the factory setting, works with 3 cycles per day. Cycle times can be modified by the customer.

1. A cycle starts with the filling (Phase 1, in the diagram below, at 9 o'clock), in which process the wastewater, freed of coarse material, is transferred out of

the buffer tank into the SBR tank via the charging pump. Filling takes place in 2-3 batches until the maximum filling level Hw,max is achieved.

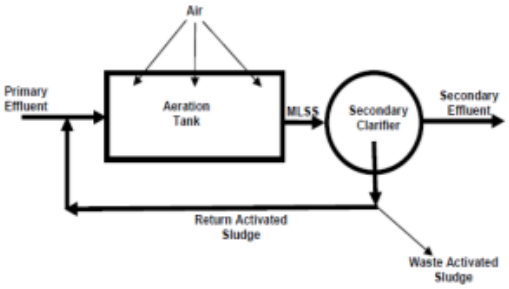


2. Denitrification begins with the charging (Phase 2). Thereby the "new" wastewater is mixed together with the volume of activated sludge present.
3. Following on from the chronologically limited denitrification phase the plant switches into the operation mode of aeration and mixing (Phase 3). With this, the oxygen necessary for the carbon degradation and the nitrification is incorporated through aerators. The aerators ensure optimum air transfer and thorough mixing of wastewater.
4. The settling phase (Phase 4), during which the activated sludge settles, begins following termination of the aeration and mixing phase.
5. In the settling phase a clarified water zone forms which is pumped out in the subsequent clarified water extraction phase (Phase 5). The float controlled extraction ends with the achievement of the filling level Hw,min. At the end of the cycle a defined portion of excess sludge is pumped from the SBR into the preliminary treatment stage or into an available sludge store. Cycle restarts.

6.2. BioSol SL36

BioSol SL36 is the natural bacteria-based product that BioPower Corporation uses to treat Pit Latrines in rural areas, which includes households and schools, Wastewater Treatment Works and Waste Stabilisation Ponds, as well as in the Flush-Tech Sanitation System as described.

By applying 50 ml of product into a single pit latrine each week, or by applying it in 5 parts per million ratios (dependent on the water quality) in Flush-Tech Sanitation Systems, WWTWs and WSPs, BioSol SL36 removes odours as well as digests sludge to reduce the waste level of the system.



BioSol SL36 works equally well in Waste Stabilisation - and Activated Sludge Systems. In the normal oxidation pond systems it works directly on the settled- and incoming sludge, whereas in the Activated Sludge process it works as follows:

The activated sludge process relies on the cultivation of a population of millions of microorganisms (MO's) of many different types, mostly aerobic and facultative heterotrophic bacteria, such as contained in BioSol SL36, being suspended in wastewater, as it passes through a reactor (aeration tank), as shown below:

This suspension, referred to as mixed liquor (or Mixed Liquor Suspended Solids, MLSS), is supplied with oxygen and kept mixed by bubbling air through the aeration tank. As such, the MO's in our product enhance naturally occurring MO's organisms already present in the primary effluent, specifically with strains of bacteria which have been optimised to rapidly degrade faecal sludge material.

Following an adequate amount of treatment time, the mixed liquor flows from the aeration tank to a secondary clarifier where the biomass is allowed to settle out of the wastewater and the effluent passes to the next treatment step. The settled biomass is returned to the treatment process to provide MO's, which will continue removing pollutants. More specifically, when BioSol SL36 is present during this sludge digestion process, subsequent multiplication of the MO's occurs with a bias in favour of non-pathogenic bacteria or biomass, for sustainable sludge breakdown, but also results in the generation of another product, namely compost, which can be used for cultivation purposes.

This returned biomass is referred to as Return Activated Sludge (RAS).

Since this is a living and growing process, it will continue to build biomass to the point of having too much. The amount of biomass in the process is controlled by removing (wasting) a portion of it on a controlled basis. This excess biomass removed from the secondary system is known as Waste Activated Sludge (WAS), which in fact can be used as compost.

6.2.1. BioSol SL36 Benefits

The usage of BioSol SL36 ensures the following benefits:

- Water Resource Management that more than complies with existing government standards;
- Odour control;
- Disease control;
- Human Waste Management through the biological digestion of sludge;
- Improve the environment; and
- Living standards and general socio-economics in communities be uplifted and the local economies boosted.

7. ESTIMATED COSTING

The proposed DEWATS systems we provide can be scaled to the exact need of the project it is earmarked for and caters for any size between a 18m^3 (18,000 litres inflow) per day to a 10Ml (10,000,000 litres inflow) per day Biological Wastewater Treatment Plant.

Notes on Flush-Tech Sanitation System (DEWATS):

1 *Escalation and inflation on building- and technology cost increases are adjusted as per board approval and published Building Cost Index every six (6) months*
2 *The following are included in the technology installation:*
   - *Site establishment:*
     Site office
     1 x Portable toilet
     Sign boards
   - *Manual Inlet Works;*
   - *Galvanised Steel tanks*
   - *FTS Technical Equipment:*
     Pumps
     Aeration
     Piping and fittings
     Control Unit
   - *Inline low - pressure Chlorinator;*
   - *Control room*
   - *Fencing*
   - *Head Office expenses*
   - *Transport*
   - *Removal of rubble*
   - *Weed control*
   - *Health and Safety*

3 *Maintenance contracts on completed Biological Wastewater Treatment Plants will be negotiated.*
4 *The above costing is for a base system only and does not constitute a quotation. Each project is site-specific and will be quoted separately.*

8. SUMMARY

The technology and products to be used is completely unique and innovative and cannot be secured from any other company. These solutions offer sustainable- and economically viable benefits for the Department of Basic Education and would improve the health- and dignity profile of the communities immensely.

8.1. Cost Savings

Various short-, medium- and long-term savings to the school, DBE, and the people:

- Savings on fresh water
- Environmental rehabilitation - Ground water, rivers, dams and lakes etc.
- General health cost saving – less hospital/ clinic intervention for waterborne diseases like cholera
- Possibility of new income streams – e.g., selling reclaimed water for non-drinking use
- Economic upliftment in the rural sector, ensuring new avenues of income

9. CONTACT DETAILS FOR THE COMPANY

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Created by BioPower Corporation – March 2021