



a world class African city



City of Johannesburg
Johannesburg Water SOC Ltd

17 Harrison Street
Johannesburg

Johannesburg Water
PO Box 61542
Marshalltown
2107

Tel +27(0) 11 688 1400
Fax +27(0) 11 688 1528

www.johannesburgwater.co.za

PARTICULAR SPECIFICATION

M22: MECHANICAL HYDRATED LIME HANDLING, STORAGE, FEEDING, WETTING AND DOSING EQUIPMENT

4	2013-10-23	Minor updates and re-issued	J Ritchie	
3	2012-07-30	General update	J Ritchie	
2	2010-02-16	General review	J Ritchie	
1	2009-05-12	Review of Mechanical / Electrical and Control / Instrumentation Standards, plus New Design Guidance		
Rev	Date	Description	Signature: JW Wastewater Partnership	Signature: Approval from Johannesburg Water

PARTICULAR SPECIFICATION M22: HDYRATED LIME HANDLING, STORAGE, FEEDING, WETTING AND DOSING EQUIPMENT

CONTENTS

M22.1	SCOPE.....	2
M22.2	INTERPRETATIONS	2
M22.2.1	Abbreviations	2
M22.2.2	Standards.....	2
M22.2.3	General Requirements.....	2
M22.3	GENERAL.....	3
M22.3.1	General Design Parameters	3
M22.4	MATERIAL HANDLING, STORAGE & LOADING	3
M22.4.1	General	3
M22.4.2	1.0 tonne or 1,0 m³ Big Bags.....	4
M22.4.3	Bulk Tanker.....	4
M22.4.4	Storage Silo/s (if applicable).....	4
M22.5	DRY FEEDING, WETTING AND DOSING.....	5
M22.5.1	General	5
M22.5.2	Bag Loading Device and Dust Extractor	5
M22.5.3	Storage / Feed Hopper	6
M22.5.4	Dry Feeder.....	6
M22.5.5	Wetting Tank.....	6
M22.5.6	Dosing Pumps	7
M22.5.7	Slurry / Solution Pipes, Hoses and Valves	7
M22.6	MATERIALS OF CONSTRUCTION & FINISH.....	8
M22.6.1	Materials of Construction.....	8
M22.6.2	Corrosion Protection	8
M22.7	INSTALLATION AND OPERATING REQUIREMENTS	9
M22.7.1	General	9
M22.7.2	Tools.....	9
M22.8	INFORMATION REQUIRED	9
M22.8.1	Manufacturing Drawings	9
M22.8.2	As Built Drawings	9
M22.9	TESTING/COMMISSIONING.....	9
M22.9.1	Preliminary test	9
M22.9.2	Acceptance test.....	10
M22.10	QUALITY MANAGEMENT	10
M22.11	MEASUREMENT AND PAYMENT.....	10
M22.11.1	General	10
M22.11.2	Testing.....	10

M22.1 SCOPE

This Specification covers the design parameters, manufacture, supply, installation, testing and commissioning of equipment for the handling, storage, feeding, wetting and dosing of hydrated lime $[\text{Ca}(\text{OH})_2]$ for use in water and wastewater treatment processes.

This specification may also be applied to the handling, storage, feeding, wetting and dosing of activated carbon powder.

It is not intended to apply to the wetting and dosing of dry Organic Polymers.

This Specification shall be read in conjunction with the Scope of Works. Clarifications to this specification are set out in the Scope of Works, which shall precede this specification in the Contract Document.

M22.2 INTERPRETATIONS

The following Interpretations relating to this specification shall form part of the Contract Document:

M22.2.1 Abbreviations

In this Specification the following abbreviations will apply:-

ANSI	: American National Standards Institute
ASTM	: American Society for Testing and Materials
BS	: British Standards Institution
SANS	: South African National Standards
SIS	: Swedish Institute of Standards
DIN	: Deutsch Industry Normen
ISO	: International Organisation for Standardization
ASME	: American Society of Mechanical Engineers
SAECC	: South African Electrolytic Corrosion Committee
AGMA	: American Gear Manufactures Association

M22.2.2 Standards

All design standards for the dosing of chemicals shall be subject to the latest amendments and editions of the following standard specifications:-

BS 5304 : Code of practice for safeguarding of machinery

M22.2.3 General Requirements

This specification shall be read in conjunction with the following specifications:-

M20: Particular Specification for Valves

M21: Particular Specification for Pressure Pipework

G01: Particular Specification for Colour Codes

G02: Particular Specification for Corrosion protection

Automation and Control Design Standards Volume 21: Load cells

M22.3 GENERAL

M22.3.1 General Design Parameters

The following requirements shall be met:-

- The equipment shall be designed to facilitate efficient manufacture, inspection, transport, installation, maintenance, cleaning and repairs.
- The equipment shall be designed to ensure safe and satisfactory operation for a life expectancy of at least 12 years under the conditions prevailing at the Site.
- The equipment shall be designed to prevent undue stresses being produced by expansion and contraction due to temperature change, and other local natural and manmade conditions.
- The equipment shall be designed to keep maintenance costs to a minimum.
- The equipment shall comply with the legal requirements in respect of safety and the prevention of environmental pollution.
- The equipment shall satisfy any specific requirement contained in the relevant statutory codes and legislation.
- The equipment shall be suitable for operation 365 days per year, 24 hours per day under the specified design conditions.
- All equipment shall be provided to provide a fully operational plant within the scope of the Contract.
- All materials from which the equipment is manufactured shall be compatible with the chemicals used and suitable for the intended duty and service conditions.
- All equipment shall be suitably treated and protected from corrosion and erosion.
- After approval by the Engineer, at the time of the award of the Contract, the information stated in the Data Sheets shall be fully complied with.
- All electrical equipment, forming part of the specified equipment, shall be sealed against penetration by the chemicals in use, which may be airborne in dust form, and be also accessible for repair and maintenance.

M22.4 MATERIAL HANDLING, STORAGE & LOADING

M22.4.1 General

Depending upon the plant size and material availability, hydrated lime will normally be supplied in one of two ways as follows, and as specified in the Scope of Works:

- (a) In 1.0 tonne or 1.0 m³ returnable fabric Big Bags – for intermediate sized applications.
- (b) By bulk tanker – for large applications.

M22.4.2 1.0 tonne or 1,0 m³ Big Bags

1.0 tonne or 1.0 m³ bags will be supplied, each on wooden pallet. The delivering truck will be equipped with a crane for off loading purposes. Alternatively the bags shall be off loaded by forklift truck.

Handling of each 1.0 Tonne bag on a pallet, at the Site, will be by forklift truck.

The bags will be stored on the pallets, in a closed building to prevent the absorption of moisture.

Each bag shall be loaded onto the top of the feed hopper, using a forklift truck, lifting frame designed to guide the big bag into position.

The square-to-round discharge cone shall be 'activated' by a vibratory motor to aid discharge, with the cone isolated on anti-vibration mounts from the lower frame.

The upper support frame shall automatically raise the bag as it empties using pre-set pneumatic cylinders to ensure complete discharge of the product.

Loading into the specially designed feed hopper shall be achieved by undoing a neck cord at the base of the bag. Access to the bag neck shall be by an access door in the outlet section of the feed hopper.

The feed hopper inlet shall be designed to retain the empty bag during loading, whilst minimising any dust being emitted from the hopper.

The Contractor shall provide the forklift bag lifting frame when specified I the Scope of Works, and the special loading chute equipment, which shall be fitted to the top of the feed hopper.

If required, the forklift truck shall be the subject of a separate contract.

M22.4.3 Bulk Tanker

The powdered lime supplied from a totally enclosed bulk tanker will be discharged by the use of an air blower mounted on the tanker, through a flexible plastic hose with quick connectors to the receiving lime silo/s at the Site. The air entering the silo shall be vented through a specially designed filtration system.

M22.4.4 Storage Silo/s (if applicable)

Storage silo/s shall be provided as follows:

Silos shall be supplied in one piece factory built construction, be vertical cylindrical, with a totally enclosed, shallow domed top, and a conical bottom with sides at not less than 60° to the horizontal. A weather proof, access manhole shall be provided in the top cover.

Each silo shall be supported on three vertical tubular legs, suitably cross braced, for stability. A caged ladder shall be provided to access the top, where handrails shall be provided around the periphery.

Each silo shall be positioned directly over the feed hopper, and connected through a large diameter pipe with an isolating knife gate valve and flexible rubber connection.

An anti-bridging activator shall be provided to ensure fluidisation of the product and a constant

flow from the silo. This shall be in the form of motorised vibrators fixed to pads on the silo cone on smaller units, or of the bin activator type fixed at the bottom of the cone on larger units.

The anti-bridging activator shall prevent the outlet from being under pressure and bridging. It shall transfer vibration to the product, breaking the forces of cohesion, which bond the particles together. Together with a timing device, the activator shall ensure that the product does not over compact and is able to flow readily at all times.

Load cells shall be fitted under the silo legs to measure the amount of material in the silo. A transmitter shall be provided, capable of transmitting a signal from the load cells to a local display and a SCADA system.

Each silo shall be provided with the special hose connection and knife gate valve, an air filtration system and all other equipment required for satisfactory and safe operation and maintenance.

M22.5 DRY FEEDING, WETTING AND DOSING

M22.5.1 General

Unless otherwise specified in the Scope of Works, each apparatus shall comprise of

- (i) A storage / feed hopper with a vibrator, bag loading facilities or silo connection, and a dust collection system.
- (ii) A hopper isolating outlet knife gate valve.
- (iii) A dry feeder.
- (iv) A wetting chamber.
- (v) A dosing pump.

The dry feeder shall discharge the dry chemical into a wetting chamber to which dilution water is added. The dilution water shall be added at a constant rate, regardless of dosage rate, sufficient to produce up to a 3%, by weight, lime slurry at the maximum feed rate specified in the Scope of Works. The resultant solution or slurry shall be conveyed to the point of application under gravity or by means of a constant rate positive displacement pump.

Dosing by gravity shall only be applicable when the dosing line is less than 10 m in length and a constant fall in the pipeline from the wetting chamber to the discharge point is possible. An open channel is to be used if dosing by gravity is applicable.

M22.5.2 Bag Loading Device and Dust Extractor

The bag loading hopper shall have a horizontally hinged door on which a bag of the relevant chemical can be placed, clamped in position, and the lower end slit. When the door is closed, the chemical shall discharge into the hopper. The door shall be sealed with a suitable seal to preclude the escape of dust during the loading operation. The bag clamping arrangement shall hold the bag firmly in such a way that sections of the bag will not tear off and be deposited in the hopper.

The dust collector unit may incorporate the bag loading hopper or may be a separate unit mounted on the bag loading hopper. The dust collector shall draw air from the hopper and pass it through filter cloth before discharging it to the atmosphere. The filter cloth shall be vibrated from time to time either automatically or manually by means of an external lever to release the

collected dust into the storage hopper.

M22.5.3 Storage / Feed Hopper

The storage hopper shall be fitted above the dry feeder. The capacity of the hopper shall be as specified in the Scope of Works. The hopper shall be manufactured from mild steel, and shall be fully three point supported either by means of a support frame, supplied as part of the equipment, or by means of a loading platform provided under the Civil Contact as shown on the drawings. A suitably sized, electrically operated, vibrator shall be fitted to the lower conical section of the hopper.

Load cells shall be fitted under the hopper feet to measure the amount of material in the hopper. In such a case a transmitter shall be provided, capable of transmitting a signal from the load cells to a PLC to activate the knife gate valve beneath the relevant silo, and to a local display and a SCADA system.

M22.5.4 Dry Feeder

Two dry feeders (one and one standby) shall be designed for feeding the dry hydrated lime. The dry feeder shall be able to be set to discharge a measured amount of chemical based on volume the duration of operation will be controlled by a timer.

The feeder shall be of the helical screw type or a rotary vane feeder.

The helical screw type shall be manufactured from grade 303 stainless steel or other similar corrosion resistant material and shall not touch the bottom of the hopper trough or the sides of the discharge tube.

An electrical heater shall be incorporated around the discharge tube to minimise the ingress of moisture at the discharge point.

The unit shall be capable of operating with a full and near empty feed hopper.

The rate of feed setting shall be on a scale graduated from 0 to 100 with scales registering both l/h and kg/h for the particular chemical concerned. The accuracy of feeding shall be within plus or minus 3.0%.

When the storage hopper exceeds 1,0 m³ capacity, the feeder unit shall be fitted with a means of vibrating the chemicals to avoid arching within the body of the feed hopper, in addition to the vibrator attached to the storage hopper. The vibrators shall be adjustably timer controlled and sized, such that bridging of the chemical does not occur, but compaction is prevented.

Feed hoppers employing reciprocating pads to prevent bridging will not be acceptable.

All bearings shall be sealed and shall be external to the feed hopper.

The feeder unit shall be constructed from stainless steel. Other proprietary items such as gearboxes and motors shall have coating system as specified, and as approved by the Engineer.

M22.5.5 Wetting Tank

The wetting tank shall be sized to provide 3 minutes retention at the maximum feed rate specified and at 3% solution strength.

The tank shall be manufactured from stainless steel and shall have an internally polished finish.

The tank shall be provided with a drain complete with valve, and a dosing outlet.

The tank contents shall be thoroughly mixed either by means of an electrically driven motorised mixer or by means of the flow pattern induced by the inlet of the dilution water, and shall be so designed as to avoid short circuiting of the chemical dosed.

The design shall ensure that no material build up can occur within the tank.

The tank shall incorporate a hinged stainless steel lid with a rubber seal, such that no dust can escape during normal operation. The lid shall give easy access for inspection and cleaning purposes.

Should the water supply to the tank fail, a flow switch shall switch off the dry feeder so that the chemical cannot build up in the wetting tank.

Should the dry feeder fail, the water supply shall be switched off so that the humidity within the tank is gradually reduced, and only a limited amount of moisture can be absorbed by the hygroscopic chemical within the feeder and cannot therefore be transmitted into the dry chemical storage hopper.

M22.5.6

Dosing Pumps

Preference is given to gravity dosing of the lime slurry in open channels however when this is not practical the slurry shall be pumped.

Peristaltic type pumps shall be used when pumping lime slurry, which could contain abrasive residues. Peristaltic pumps shall be selected to run at no more than 50% of the maximum design speed for that size of pump. They shall be totally enclosed, with an oil bath lubricant to ensure minimal wear on the peristaltic hose and slider pads. A sight glass shall be installed on the outside of the pump to view lubricant level and top up the lubricant. In the event of a hose failure, replacement of the hose shall be quick and easy without major dismantling of the pump and pipework.

When pumping slurry solutions with no abrasive residue, progressive cavity rotating helix type pumps may be used.

Pumps shall be driven direct through an oil lubricated helical or planetary type reduction gearbox and motor, which shall be speed controlled by VSD unit from a 4 to 20 milliamp signal. The maximum pump design speed shall equate to a frequency of 50 Hz.

The pumps shall each be provided with a flow measuring system, to switch off the relevant pump and prevent any damage in the event of an isolating valve being closed.

Peristaltic pumps are of the positive displacement pulsation type and the pulsations may damage the discharge piping. Measures shall be taken to prevent any such damage with the installation of suitable pulsation dampers or adequate lengths of flexible hose of the 'Heliflex' or synthetic rubber type.

M22.5.7

Slurry / Solution Pipes, Hoses and Valves

Whenever possible, and when there are multiple feed hoppers / wetting chambers, one pump should be dedicated to each feed hopper / wetting chamber. In this way, the piping system may be simplified and dead pipe legs minimised. When this is not possible, the system shall be complete with all necessary suction piping and valves for connecting to the wetting tank/s. The delivery piping shall include isolating valves when duty and standby pumps are to be provided. In this case, consideration shall be given to the sedimentation of settleable solids in pipe legs with no flow, to prevent blockage.

When pumping lime slurries, two delivery hoses per dosing point shall be provided in parallel between the pump/s and the dosing point. In this manner any calcium carbonate build up, or sedimentation, within the pipe can be cleaned out, without the dosing being interrupted. Such hoses shall be of the flexible synthetic rubber type, and shall be resistant to the effect of the lime and also to the effect of prolonged periods of direct sunlight.

Pipes transporting lime slurry shall be run such that they are always full, to prevent the absorption of CO₂ from any air within the pipeline.

Pipe connections at the point of application and at the pump or wetting chamber shall facilitate easy and quick installation of a spare hose in the event of failure of the work hose.

The velocity of flow in the pipes shall be sufficient to avoid precipitation or sedimentation within the pipeline.

Pipes and hoses shall be of non-flame propagating materials. They shall be arranged for easy dismantling for cleaning, and, if screwed joints or joints formed by solvent welding are proposed, enough flanged or flexible joints shall be provided to enable the pipework to be removed in sections without working from one end to the other of a particular run. Tees and cocks shall also be provided at convenient points for the connection of a pressure water supply to flush pipework through as required.

M22.6 MATERIALS OF CONSTRUCTION & FINISH

M22.6.1 Materials of Construction

Hand Trolley (if applicable)	: Mild Steel
Forklift Bag Lifting Frame (if applicable)	: Mild Steel
Storage Silo (if applicable)	: Mild Steel
Ladder & Cage (if applicable)	: Mild Steel
Hand Railing (if applicable)	: Mild Steel
Discharge Chute	: Mild Steel
Chemical Lift	: Mild Steel
Bag Loading Hopper	: Mild Steel
Feed Hopper	: Mild Steel
Dry Feeder	: 304 Stainless Steel
Wetting Chamber & Lid	: 316 Stainless Steel
Water Supply Piping	: Mild Steel
Slurry Piping (indoors)	: Flexible Hose/Polyprop.
Slurry Piping (outside)	: HDPE
Bolts & Nuts `	: 304 Stainless Steel
Concrete Anchors	: 304 Stainless Steel

M22.6.2 Corrosion Protection

Hand Trolley (if applicable)	: Hot Dip Galvanised
Forklift Bag Lifting Frame (if applicable)	: Hot Dip Galvanised
Storage Silo (if applicable)	: Supplier Specific

Ladder & Cage (if applicable)	: Hot Dip Galvanised
Hand Railing (if applicable)	: Hot Dip Galvanised
Discharge Chute	: Supplier Specific
Chemical Lift	: Hot Dip Galvanised
Bag Loading Hopper	: Supplier Specific
Feed Hopper	: Supplier Specific
Dry Feeder	: Blast Finish
Wetting Chamber & Lid	: Polished
Water Supply Piping	: Hot Dip Galvanised

M22.7 INSTALLATION AND OPERATING REQUIREMENTS

M22.7.1 General

The feeder and associated equipment shall operate continuously over the full dosage range. Variation in the feed rate shall be achieved by varying the speed of rotation of the helical screw.

With bulk tanker material supply and silo storage, and when specified in the Scope of Works, the plant shall be automated such that only the relevant duty storage and dosing train is manually selected, and a manual call for silo filling is required. In such a case, feed hopper filling, and regulation of dosing and pumping, for the selected duty train/s shall be fully automatic.

M22.7.2 Tools

A wall mounted toolbox shall be provided and mounted as directed by the Engineer. It shall contain all tools required to service and maintain all the equipment provided.

M22.8 INFORMATION REQUIRED

M22.8.1 Manufacturing Drawings

The Contractor shall inform the Engineer prior to the manufacture of any piece of equipment of the availability of the relevant general arrangement drawings for inspection and approval by the Engineer to be made available at the Engineer's office. The Contract will be deemed incomplete until the Contractor has made available these drawings to the Engineer, and they have been checked and approved.

M22.8.2 As Built Drawings

The Contractor shall provide 'To Scale' as built General Arrangement Drawings of all the relevant equipment. Such drawings shall be made available in a recognized electronic format such as AutoCAD.

M22.9 TESTING/COMMISSIONING

Two series of tests shall be conducted on the equipment, as specified hereunder.

M22.9.1 Preliminary test

Before delivery of the equipment is accepted, each item of mechanised equipment shall be tested, at the supplier's works, throughout the operating range using the chemicals which the

equipment is required to dose. Calibration curves to demonstrate compliance with the specification shall be plotted and submitted to the Engineer.

M22.9.2 Acceptance test

After installation of the equipment and before commissioning, each item of mechanised equipment shall be tested throughout its operating range and calibration curves shall be produced. The calibration curves shall be incorporated into the operating and maintenance instructions.

M22.10 QUALITY MANAGEMENT

Quality management criticality categorization : Major.

M22.11 MEASUREMENT AND PAYMENT

M22.11.1 General

Measurement and payment will distinguish between supply/delivery and installation/commission for each item of equipment as listed and priced only in the Schedule of Quantities. Payment will not be made for part supply of any listed item.

The respective tender item rates shall be deemed to cover all costs of equipment required within the scope of this Contract.

The tendered rates or sums shall cover the cost of design, drawings, manufacture, supply, testing at the manufacturers works, delivery to site, off loading, installation, site testing, setting into operation, the supply of O & M manuals, commissioning and maintenance during the warranty period of all equipment specified and also for anything not specifically mentioned but obviously required, (e.g. all ancillaries, including all bolts, fastenings and brackets, safety guards and any work or material required for the proper installation of such equipment) to enable the equipment to be installed and/or function safely and correctly as specified. No claims whatsoever for extras will be allowed on the grounds that a necessary piece of equipment or a part thereof is not specifically mentioned.

M22.11.2 Testing

The tendered sum shall cover the cost of all plant and personnel for conducting the testing, and in the case of the workshop and preliminary testing shall include the cost of any consumables. For the acceptance testing, the consumables will be provided for the initial test only, by the Employer.