

**Standard for the
Supply of Aluminium
Sulphate for Use in
Water Treatment**

Second Edition

January 1997



STANDARD FOR THE SUPPLY OF ALUMINIUM SULPHATE FOR USE IN WATER TREATMENT

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Published by:
New Zealand Water & Wastes Association
P O Box 13880, Onehunga, Auckland
Phone: 09 636 3636, Fax: 09 636 1234
Email: water@nzwwa.org.nz, Website: www.nzwwa.org.nz

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1 GENERAL

1.1 Scope

This Standard covers aluminium sulphate (commonly called alum) in liquid, ground, lump, kibbled or flake form, for use in the treatment of water supplies.

1.2 Purpose

The main purpose of this Standard is to provide purchasers, manufacturers and suppliers with the minimum requirements for aluminium sulphate, including physical, chemical and testing requirements.

1.3 Application

This Standard can be referenced in specifications for purchasing and receiving aluminium sulphate and can be used as a guide for testing the physical and chemical properties of aluminium sulphate samples. The stipulations of this Standard apply when this document has been referenced and only to aluminium sulphate used in water treatment.

1.4 Uses in Water Treatment

Aluminium sulphate is used in the water treatment industry for the coagulation of organic and mineral colloids prior to sedimentation and/or filtration. The alum destabilises fine colloidal suspensions and promotes the forming together of large conglomerations of this material bound in a chemical precipitate (called floc) which is able to be removed from the water by sedimentation, flotation and/or filtration.

1.5 Manufacture of Aluminium Sulphate

Aluminium sulphate is prepared from alumina bearing ores (aluminium trihydrate or bauxite) by treating with sulphuric acid at elevated temperatures. The supernatant solution is either decanted and sold in liquid form or concentrated and allowed to crystallise into a solid, dry, hydrated product.

1.6 Description of Chemicals

Aluminium sulphate is available in the following forms in New Zealand:

- Ground
- Lump (kibbled)
- Flaked
- Liquid

Ground alum is available in New Zealand as a fine white powder which comes in 25-50 kg bag lots.

Lump (kibbled) alum is in a lump form (approximately 10-75 mm sieve diameter size) and generally comes in 25-50 kg bag lots.

Flaked alum is in the form of flakes (approximately 1mm thick and varying from 3 - 25 mm across) and generally comes in 25-50 kg bag lots.

Liquid alum is usually a 47% weight for weight (w/w) solution that can either be purchased in 200 L drums or via bulk tanker.

1.7 Methods of Dosing

Aluminium sulphate is dosed as liquid solution, usually between 5-47% w/w. It is usually dosed via diaphragm pumps into an area of high water turbulence to facilitate rapid mixing of the alum with the recipient water. It is normal to pump the alum solution into additional dilution water when dosing strong solutions in order to facilitate good mixing and rapid coagulation in the raw water.

1.8 Definitions

The following definitions shall apply in this Standard:

- | | | |
|-------|----------------------------|---|
| 1.8.1 | <i>Alum:</i> | Alum also refers to aluminium sulphate. |
| 1.8.2 | <i>Aluminium Sulphate:</i> | The product of the reaction between sulphuric acid and aluminium trihydrate, with the general formula $Al_2(SO_4)_3 \cdot 14H_2O$, but note that the number of waters of crystallisation is only approximate. "Pure" alum is the 181-120 product; commercial grades can vary from about 13.9-14.5H ₂ O. |
| 1.8.3 | <i>Manufacturer:</i> | The party that manufactures fabricates or produces materials or products. |
| 1.8.4 | <i>Purchaser:</i> | The person, company or organisation that purchases any materials or work to be performed. |
| 1.8.5 | <i>Reception Point:</i> | The point of physical transfer of materials from the supplier to the purchaser. |
| 1.8.6 | <i>Supplier:</i> | The party who supplies material or services. A supplier may or may not be the manufacturer. |
| 1.8.7 | <i>w/w</i> | weight for weight. |
| 1.8.8 | <i>cP</i> | centipoise, a unit of viscosity (see Table 1). |

2 MATERIALS

2.1 Physical Properties

2.1.1 Solid aluminium sulphate shall be dry, clean, and shall be lump, ground or flaked, as specified. Liquid aluminium sulphate is a nearly saturated solution of aluminium sulphate and shall be of such clarity as to permit the reading of storage tank contents sight glasses without difficulty.

2.1.2 Some physical properties of the forms of alum are listed in Table 1:

Property	Form of Aluminium Sulphate			
	Ground	Flaked	Kibbled	Liquid*
pH of 50% solution w/w	2.0	2.0	2.0	2.0-2.4
Specific Gravity	1.77	1.77	1.77	1.31-1.33 @ 15°C
Bulk Density	1,100 kg/m ³	750 kg/m ³	800 kg/m ³	N/A
Particle Size	Min 90% < 6.3 mm sieve size, max 12% < 0.1 mm sieve.	3-25mm dia 1mm thick	10-75 mm sieve	N/A
Viscosity	N/A	N/A	N/A	27 cP @ 10°C 19 cP @ 20°C

*Figures are given for a 47% w/w solution of aluminium sulphate.

Table 1: Some Physical Properties of the Different Forms of Aluminium Sulphate

2.2 Chemical Requirements

2.2.1 Lump (kibbled), ground, or flaked aluminium sulphate shall contain water-soluble aluminium of not less than 9.0% w/w as Al or 17.0% w/w as Al₂O₃.

2.2.2 Liquid aluminium sulphate shall contain water-soluble aluminium of not less than 4.23% w/w as Al or 8.0% w/w as Al₂O₃.

2.2.3 Excess water soluble Al₂O₃ shall be at least 0.025%.

2.2.4 In lump, ground or flaked aluminium sulphate, the water-insoluble matter shall not exceed 0.5% w/w.

2.2.5 In liquid aluminium sulphate, the water-insoluble matter shall not exceed 0.2% w/w.

Note 1:

the atomic weight of aluminium is 26.9815

the atomic weight of oxygen is 15.9994

so the molecular weight of Al₂O₃ is 101.9612

so the conversion factor from Al to Al₂O₃ is $101.9612 \div 53.9630 = 1.889$.

Note 2:

the atomic weight of hydrogen is 1.0079

and the atomic weight of sulphur is 32.0600

so the molecular weight of alum or $\text{Al}_2(\text{SO}_4)_3 \cdot 14\text{H}_2\text{O}$ is 594.3486

so the conversion factor from Al to "alum" is 11.014, or approximately 11.

Note 3:

if an alum delivery has a specific gravity of 1.31 and it is 8.1% w/w Al_2O_3 , then it is 4.288% w/w as Al, and $4.288 \times 1.31 = 5.617\%$ w/v Al, or 61.868% w/v as "alum".

2.3 Impurities

2.3.1 Specific Impurity Limits

2.3.1.1 The limits of specific impurities in aluminium sulphate shall be set by the purchaser. In setting impurity limits the purchaser shall take into consideration the expected maximum dosage (MD) of aluminium sulphate, the maximum acceptable value (MAV) of a parameter taken from the Drinking-Water Standards for New Zealand 1995 and a safety factor which reflects the maximum percentage of a MAV that may be contributed by a specific impurity. The specific impurity limits shall be calculated using the following equation.

$$SIL = \frac{MAV (mg / litre) \times 10^6 (mg / kg)}{MD (mg / litre) \times SF}$$

Where	SIL	=	Specific Impurity Limit
	MAV	=	Maximum Acceptable Value
	MD	=	Maximum Dosage
	SF	=	Safety Factor

2.3.1.2 Appendix A sets out some example calculations for the determination of specific impurity limits, along with a table of impurity limits based on a maximum dosage of 100 mg of aluminium sulphate/litre of water and a safety factor of 10. A table of MAVs taken from the Drinking-Water Standards for New Zealand 1995 is also presented in Appendix A.

2.3.1.3 Alternative MAVs to those in the Drinking-water Standards for New Zealand may be chosen by the purchaser to reflect their individual requirements (e.g., fluoride). The purchaser may also vary the SF to suit

2.3.1.4 Specific impurity limits shall be given as weight of impurity by weight of aluminium sulphate, calculated on the basis of $\text{Al}_2(\text{SO}_4)_3 \cdot 14\text{H}_2\text{O}$.

2.3.2 General Impurities

In addition to the above specific impurities, aluminium sulphate shall not contain any other impurities that may be deleterious to health or aesthetically objectionable as determined in the Drinking-water Standards for New Zealand. General impurity limits shall be based on a maximum dosage of 100 mg/L of aluminium sulphate, the MAV of determinands and a minimum safety factor of 10.

3 DELIVERY

3.1 Packaging and Shipping

- 3.1.1 Solid aluminium sulphate may be shipped in 25 kg to 50 kg bags. Liquid alum may be shipped in bulk, or in 200 litre drums.
- 3.1.2 Tanks for transporting liquid alum shall comply with all conditions as required under the Transport Act 1992 and shall not contain any substances that might affect the quality of the liquid alum in treating water supplies.

3.2 Labelling

Each shipment of material shall comply with the New Zealand Standard NZS 5433:1988, *Code of Practice for the Transport of Hazardous Substances on Land* and specifically must be clearly identifiable and be marked and/or accompanied by clear means of giving the following information:

Contents :	Aluminium Sulphate
Net weight	
Name of manufacturer:	
Hazardous Chemical Classification:	

3.3 Unloading and Storage

- 3.3.1 Bulk liquid alum shall be unloaded at the purchaser's premises using either a gravity discharge or a pump to fill the storage tanks. The supplier shall provide an appropriate "camlock" or other type of coupling as agreed with the purchaser for connection to the storage tank inlets if required, in order to prevent discharge to incorrect tanks.
- 3.3.2 Empty bulk trucks shall not be washed out at the delivery site without the express approval of the purchaser's representative or operating personnel.
- 3.3.3 Bags or drums shall be unloaded with a forklift or by hand, and shall be stored in a dry, covered, designated storage area, because solid alum absorbs moisture from the air. Bags shall be stored on wooden pallets.
- 3.3.4 Bags damaged prior to delivery will be the responsibility of the supplier and bags damaged during unloading at the purchaser's premises will be the responsibility of the agent undertaking the unloading.

4 SAFETY

4.1 Health and Safety

4.1.1 Suppliers of aluminium sulphate must comply with the requirements of the Health and Safety in Employment Act 1992 and take all practicable steps to protect the purchaser and others from hazards rising from the transportation, delivery and supply of aluminium sulphate.

4.1.2 Within two weeks of award of a contract to supply product and prior to delivery the supplier shall provide to the purchaser the following information:

(a) An updated copy of the Material Safety Data Sheet, which as a minimum shall include the following information, as detailed in *Guidance Note for Completion of a Material Safety Data Sheet*, [NOHSC:3001 (1991)]:

- Introductory and Company Details
 - Page numbers and total
 - Date of issue
 - Company, address and phone numbers
- Identification
 - Product names, codes and numbers
 - Physical description/properties
 - Chemical properties
 - Other properties
 - Uses
- Health Hazard Information
 - Health effects
 - First aid
- Precautions for Use
- Safe Handling Information
- Other Information and Emergency Contacts

(b) Evidence that drivers have been adequately trained and have adequate knowledge and experience in the handling and delivery of aluminium sulphate.

4.1.3 A copy of the purchaser's Health and Safety Management Plan shall be made available to the supplier of aluminium sulphate. Any practices by the supplier which do not comply with the Health and Safety Management Plan may be grounds for the termination of a supply contract. Health and Safety Management Plans are discussed in the National Guidelines for Health and Safety in the New Zealand Water Industry (1997).

4.2 Protective Equipment

The purchaser and the supplier will be responsible for providing their respective personnel or agents with any necessary safety and protective equipment identified in their Health and Safety Management Plans and ensuring it is used as required.

4.3 Spills

The supplier, their agent or the authorised purchaser's representative responsible for unloading the aluminium sulphate, shall immediately attend to and report any spills within the grounds of the property in which the aluminium sulphate reception point is located. Clean-up *and* reporting procedures should be specified in Health and Safety Management Plans; they may also be specified in the water treatment plant Consent issued by the Regional Council.

5 TESTING METHODS

5.1 General

- 5.1.1 The manufacturer or supplier shall test the materials at their own cost in order to provide a Certificate of Compliance as required in Section 7.1.
- 5.1.2 The purchaser may randomly take samples of the material and have these samples analysed for conformance with this Standard, at the cost of the purchaser. These samples shall be taken at the place of manufacture and/or at the delivery point, as may be agreed upon by the manufacturer or supplier and the purchaser.
- 5.1.3 When inspection and sampling are to be conducted at the point of manufacture, the manufacturer shall afford the inspector representing the purchaser all reasonable facilities for inspection and sampling of finished material, which shall be so conducted as not to interfere unnecessarily with the operation of the plant.
- 5.1.4 Analytical testing methods shall be as specified in this Standard in Section 5.4.
- 5.1.5 If the analysis of a sample taken at the place of manufacture shows the material does not comply with the requirements of this Standard, the purchaser may require that the manufacturer provide a certified analysis from a suitably Telarc registered organisation (or equivalent) for successive deliveries.
- 5.1.6 If the analysis of a sample taken at the point of delivery shows the material does not comply with the requirements of this Standard, a notice of non-conformance must be provided by the purchaser to the supplier in accordance with Section 7.4.

5.2 Sampling

- 5.2.1 The sampling procedure shall be agreed by the purchaser and supplier prior to the award of a contract to supply product.
- 5.2.2 The sample size shall be determined in order to provide a representative sample of the material and shall be agreed by the purchaser and the supplier.
- 5.2.3 A suitable sampling procedure is set out in Appendix B of this Standard.

5.3 Sample Preparation

- 5.3.1 Prior to the award of the contract to supply product the preparation of the sample for analysis shall be agreed by the purchaser and supplier giving consideration to the analytical testing to be undertaken, given that samples prepared by different methods may give different results when tested.
- 5.3.2 A suitable sample preparation procedure for the analytical tests detailed in Section 5.4.2 is set out in Appendix B of this Standard.

5.4 Standard Tests

- 5.4.1 For the standard test methods for the following properties of aluminium sulphate refer to ANSI/AWWA Standard B403-88, Section 4, pp 6-11.

- Specific Gravity
- Water Insoluble Matter
- Total Soluble Alumina and Aluminium
- Total Water Soluble Iron
- Ferric Iron
- Ferrous Iron
- Basicity and/or Free Acid.

An alternative method for Total Alumina in Aluminium Sulphate is also given in ANSI/AWWA Standard B403-88, Section 4, pp 11-13.

5.4.2 Test methods for specific impurities can be found in *Standard Methods for the Examination of Water and Wastewater*, 19th Edition, 1995. Samples require appropriate preparation. Methods for some parameters are given under the following codes:

Arsenic	3500-As, pp 3-49 to 3-51
Boron	4500-B, pp 4-8 to 4-10
Cadmium	3500-Cd, p. 3-55 to 3-56
Chromium	3500-Cr, pp 3-58 to 3-62
Fluoride	4500-F, pp 4-59 to 4-64
Iron	3500-Fe, pp 3-67 to 3-70
Lead	3500-Pb, pp 3-71 to 3-72
Manganese	3500-Mn, pp 3-76 to 3-78
Mercury	3500-Hg, pp 3-78 to 3-80
Selenium	3500-Se, pp 3-85 to 3-93

6 SUPPLY CONTRACT

6.1 Contract

The purchaser may enter into a contract with a supplier for the supply of aluminium sulphate in accordance with this Standard.

6.2 Acceptable Conditions

Acceptable conditions of supply are outlined in Appendix C of this Standard or as agreed between the supplier and the purchaser.

7 QUALITY ASSURANCE

7.1 Certificate of Compliance

- 7.1.1 The manufacturer or supplier shall provide the purchaser with a certificate of compliance that states that the material furnished in accordance with the purchaser's order complies with all applicable requirements of this Standard.
- 7.1.2 The purchaser may require that the supplier provide a certified analysis of the material, from a mutually agreed upon laboratory at the commencement of the contract and thereafter at 3 monthly intervals or as agreed between purchaser and supplier. The purchaser may also require that the supplier provide a certified analysis for insoluble matter or particular impurities, from a mutually agreed upon laboratory, for each delivery.

7.2 Method of Manufacture

- 7.2.1 The quality of a water treatment chemical is greatly influenced by the method of manufacture and quality of raw material used. If other than recognised methods of manufacture, or if unusual raw materials are used, the potential may exist for impurities to be present, or poor quality chemical to be produced, that may be inconsistent with good water treatment practice.
- 7.2.2 If the method of manufacture, source and/or quality of raw material used is changed during the period of the contract, then additional samples shall be analysed at the manufacturer's or supplier's cost, to demonstrate that the changes have not affected compliance with this Standard.

7.3 Weight Certificate

Delivered bulk product shall be weighed over certified weighbridges and the docket produced on delivery.

7.4 Rejection

7.4.1 Notice of Non-conformance

If the aluminium sulphate delivered does not meet the requirements of this Standard, a notice of non-conformance must be provided by the purchaser to the supplier within ten working days after receipt of the shipment at the point of destination. The results of the purchaser's tests shall prevail unless the supplier notifies the purchaser within five working days after receipt of the notice of complaint that a retest or inspection is desired. On receipt of the request for a retest, the purchaser shall forward to the supplier one of the sealed samples taken in accordance with Section 5. In the event that the results obtained by the supplier upon retesting do not agree with the results obtained by the purchaser, the other sealed sample shall be forwarded, unopened, for analysis to a referee laboratory agreed upon by both parties. The results of the referee analysis or inspection shall be accepted as final.

The cost of the referee analysis shall be paid by the supplier if the material does not meet the requirements of this Standard, and shall be paid by the purchaser if the material does meet the requirements of this Standard.

7.4.2 **Material Removal**

- 7.4.2.1 If the material does not meet the impurity limit requirements of this Standard, the supplier shall remove the material from the premises of the purchaser when requested by the purchaser. Removal of material shall be at no cost to the purchaser.
- 7.4.2.2 If the material meets the impurity limits but not the water soluble aluminium or water insoluble matter content requirements of this Standard, a price adjustment may be agreed between the supplier and the purchaser. In the event that a price adjustment cannot be agreed, the supplier shall remove the material from the premises of the purchaser if required by and at no cost to the purchaser.
- 7.4.2.3 The material that shall be removed shall include the rejected material and any other material the rejected material may have contaminated, for example contents of a tank into which a bulk delivery has been unloaded, if required by the purchaser.
- 7.4.2.4 All material removed shall be concurrently replaced with material conforming to this Standard with an appropriate compliance certificate at no cost to the purchaser.

Appendix A: Specific Impurity Limits

A1 Example Calculations

Specific Impurity Limits (SIL) have been calculated based on a maximum dosage (MD) of aluminium sulphate/litre of water and the maximum acceptable value (MAV) of a parameter taken from the Drinking-Water Standards for New Zealand 1995. The safety factor (SF) used in the calculation of the SIL is 10, which reflects the view that no more than 10 percent of a MAV should be contributed by a given impurity in a water treatment chemical.

The SIL, values were determined using the following equation:

$$SIL = \frac{MAV (mg/L) \times 10^6 mg/kg}{MD (mg/L) \times SF}$$

Example calculations are as follows:

Arsenic:	MAV	=	0.01 mg/L
	MD	=	100 mg/L
	SF	=	10

$$SIL (As) = \frac{0.01 \times 10^6}{100 \times 10}$$

$$= 10 \text{ mg/kg}$$

Boron:	MAV	=	0.3 mg/L
	MD	=	100 mg/L
	SF	=	10

$$SIL (B) = \frac{0.3 \times 10^6}{100 \times 10}$$

$$= 300 \text{ mg/kg}$$

A2 Specific impurity Limits based on maximum dosage of 100 mg of aluminium sulphate per litre of water, and a safety factor of 10

Antimony	3 mg Sb/kg $\text{Al}_2(\text{SO}_4)_3 \cdot 14\text{H}_2\text{O}$
Arsenic	10 mg As/kg $\text{Al}_2(\text{SO}_4)_3 \cdot 14\text{H}_2\text{O}$
Barium	700 mg Ba/kg $\text{Al}_2(\text{SO}_4)_3 \cdot 14\text{H}_2\text{O}$
Boron	300 mg B/kg $\text{Al}_2(\text{SO}_4)_3 \cdot 14\text{H}_2\text{O}$
Cadmium	3 mg Cd/kg $\text{Al}_2(\text{SO}_4)_3 \cdot 14\text{H}_2\text{O}$
Chromium	50 mg Cr/kg $\text{Al}_2(\text{SO}_4)_3 \cdot 14\text{H}_2\text{O}$
Copper	1000 mg Cu/kg $\text{Al}_2(\text{SO}_4)_3 \cdot 14\text{H}_2\text{O}$
Fluoride	1500 mg F/kg $\text{Al}_2(\text{SO}_4)_3 \cdot 14\text{H}_2\text{O}$
Iron	200 mg Fe/kg $\text{Al}_2(\text{SO}_4)_3 \cdot 14\text{H}_2\text{O}$
Lead	10 mg Pb/kg $\text{Al}_2(\text{SO}_4)_3 \cdot 14\text{H}_2\text{O}$
Manganese	500 mg Mn/kg $\text{Al}_2(\text{SO}_4)_3 \cdot 14\text{H}_2\text{O}$
Mercury	2 mg Hg/kg $\text{Al}_2(\text{SO}_4)_3 \cdot 14\text{H}_2\text{O}$
Molybdenum	70 mg Mo/kg $\text{Al}_2(\text{SO}_4)_3 \cdot 14\text{H}_2\text{O}$
Nickel	20 mg Ni/kg $\text{Al}_2(\text{SO}_4)_3 \cdot 14\text{H}_2\text{O}$
Selenium	10 mg Se/kg $\text{Al}_2(\text{SO}_4)_3 \cdot 14\text{H}_2\text{O}$
Zinc	3000 mg Zn/kg $\text{Al}_2(\text{SO}_4)_3 \cdot 14\text{H}_2\text{O}$

Note that the safety factor for many of the above will actually be greater than 10 because it is likely that some of the impurities will be removed in the coagulation and filtration processes. This will be particularly so in the case of iron, in fact iron impurities could enhance the treatment process.

The above table of specific impurity limits has been calculated based on the maximum acceptable value (MAV) of a determinand taken from the Drinking-Water Standards for New Zealand 1995, as follows:

Antimony	0.003 mg/L
Arsenic	0.01 mg/L
Barium	0.7 mg/L
Boron	0.3 mg/L
Cadmium	0.003 mg/L
Chromium	0.05 mg/L
Copper *	1 mg/L
Fluoride	1.5 mg/L
Iron *	0.2 mg/L
Lead	0.01 mg/L
Manganese	0.5 mg/L
Mercury	0.002 mg/L
Molybdenum	0.07 mg/L
Nickel	0.02 mg/L
Selenium	0.01 mg/L
Zinc *	3 mg/L

* For aesthetic parameters, guideline values are given.

Appendix B: Sampling Procedure

B1 Sampling Method

B1.1 General

- B1.1.1 Sampling and preparation shall be conducted as expeditiously as possible in order to avoid undue exposure of the material to the air, thus avoiding contamination and evaporation.
- B1.1.2 The sampling method must give a gross sample that is representative of the material, and which may be divided to provide representative samples for analysis. Samples for analysis shall be provided in triplicate. Samples shall be sealed in airtight moisture proof containers.
- B1.1.3 One sample is for the immediate use of the purchaser for testing of the shipment. The other two samples shall be retained until it is known from the results of the laboratory examination that the shipment meets the requirements of this Standard. The second sample shall be delivered to the supplier if requested within five days of notification of the examination results of the first sample. The third sample is for the use of a referee laboratory if there is a controversy over the analyses.
- B1.1.4 Each sample shall be labelled to identify it by such information as the name of the purchaser package number, and date received. Each label shall be signed by the sampler.

B1.2 Sample Size

- B1.2.1 The sample size must provide a gross sample that is representative of the material.
- B1.2.2 The size of the gross sample and the samples for analysis shall be agreed by the purchaser and the supplier, giving consideration to obtaining representative samples and the requirements of the laboratory to undertake analyses.

B1.3 Solid Aluminium Sulphate

- B1.3.1 If the alum is packaged, 5% of the number of the packages shall be sampled. No sample shall be taken from a broken package.
- B1.3.2 Care shall be taken to include a proportional amount of lumps and fines, to obtain representative material.
- B1.3.3 Ground aluminium sulphate shall be sampled using a sampling tube or other effective device that measures at least 2 cm in diameter.
- B1.3.4 Kibbled alum (or lumps) shall be sampled from the container by removing an assortment of different sized lumps by hand (wearing clean gloves).
- B1.3.5 The gross sample, of at least 16 kg or as agreed, shall be crushed, if necessary, and mixed thoroughly and divided to provide three 0.5 kg samples. These samples shall be sealed in air tight, moisture-proof, glass containers.
- B1.3.6 Each sample container shall be labelled to identify it and shall be signed by the sampler.

B 1.4 Liquid Aluminium Sulphate

- B1.4.1 Equal portions shall be taken at four equally spaced time intervals during the unloading of the tank truck. The total sample volume shall equal 2 litres, or as agreed. Special sampling arrangements may be necessary at unmanned water treatment plants, particularly if a new load is pumped into a tank that still has some alum in it.
- B1.4.2 The gross sample (2 litres) should be thoroughly mixed, and three 0.5 litres samples retained. They shall be sealed in air tight glass containers.
- B 1.4.3 Each sample container shall be labelled to identify it and shall be signed by the sampler.

B2 Sample Preparation

- B2.1 The preparation of subsamples for testing may affect the results obtained from identical samples so appropriate and consistent preparation procedures are most important.
- B2.2 An appropriate preparation technique must be agreed by the purchaser and the supplier following discussions with all parties, including the laboratory undertaking the analyses, with regard to the objectives of the analyses and the desired results.
- B2.3 A suggested sample preparation method to determine the "total" determinand present, as compared to a method appropriate for the determination of "water soluble" determinands, is as follows:
- B2.3.1 A vigorous acid digestion of the sample would be required, that would provide a prepared sample suitable for an approved analysis.
- B2.3.2 AWWA Standard Methods for the Examination of Water and Wastewater suggests that as a general rule Nitric Acid digestion alone is adequate for samples containing easily oxidised materials.
- B2.3.3 Nitric Acid - Sulphuric Acid digestion or Nitric - Hydrochloric Acid (Aqua Regia) digestion is adequate for samples with readily oxidisable organic matter.
- B2.3.4 Nitric - Perchloric Acid digestion or Nitric - Perchloric - Hydrofluoric Acid digestion is necessary for samples containing difficult to oxidise organic matter or minerals.
- B2.3 The mutually agreed sample preparation method will depend on the determinands to be measured and the equipment available for preparation and testing by the laboratory.
- B2.4 As an alternative, some non-destructive techniques are available, such as X-ray spectrophotometry, for total elemental analysis of solid samples, which do not require an acid digestion preparation.

Appendix C: Supply Contract

C1 Contract

The following provides an outline of acceptable conditions of supply of product, to be included in a contract between a purchaser and a supplier for the supply of aluminium sulphate in accordance with this Standard, or as agreed by the purchaser and the supplier.

C2 Contract Period

A nominated contract period shall be set as part of a supply contract and shall commence from the date of entering into contract.

C3 Annual Requirements

An approximate annual requirement of product shall be provided for the information of the supplier. However, no guarantee can be given to these amounts as they will vary with water treatment plant throughput, water quality and customer consumption.

C4 Delivery

- C4.1 The reception point for the supply of aluminium sulphate shall be designated and agreed between the supplier and the purchaser.
- C4.2 Delivery of an order, to the purchaser's specified reception point shall be made within 7 days of receipt of the order or at any other mutually agreed time.
- C4.3 Delivery of bulk liquid alum shall be in full tanker or compartment loads, unless there is prior agreement between the supplier and the purchaser has been reached as to the load size.
- C4.4 Delivery shall be made between the hours of 7.30 am and 4.00 pm Monday to Friday, excluding public holidays unless a prior arrangement is made between the supplier and the purchaser, and discharged only with the authorisation of the purchaser's representative or operating personnel.
- C4.5 Delivery dockets shall be provided giving the weight of the product and the % of w/w of water soluble Alum. Bulk deliveries shall be weighed over certified weighbridges.
- C4.6 The purchaser may check the solution strength (in the case of liquid alum) after delivery.

C5 Payment

- C5.1 Payment will be made in full by the purchaser by the 20th of the month following that in which deliveries are made and correctly invoiced by the supplier unless otherwise agreed.
- C5.2 Invoices shall state the order number, docket number, weight of product supplied.
- C5.3 Payment will be made on measured quantities unless otherwise agreed.

C6 Contract Sum

- C6.1 Suppliers shall submit quotes in NZ\$/tonne for the product offered. The quoted price shall allow for delivery including off-loading to the nominated reception points unless otherwise agreed. The price should indicate clearly whether it is for a tonne of dry weight equivalent, ie of $\text{Al}_2(\text{SO}_4)_3 \cdot 14\text{H}_2\text{O}$, or some other basis.
- C6.2 The quote shall hold firm for the duration of the contract period.
- C6.3 The quote shall be exclusive of GST, but inclusive of any applicable duties or charges.

C7 Insurance

The supplier shall make their own arrangements for insurance of the order while in transit to the reception point. Responsibility will pass to the purchaser once the delivery has been made to the purchaser's storage facility.

C8 Subletting

The supplier shall not assign or sublet the contract or any part of the contract without the written consent of the purchaser.

C9 Cancellation

The purchaser shall reserve the right to cancel the contract for non-compliance with the Standard or failure to deliver within the allotted time.

REFERENCES

ANSI/AWWA Standard for Aluminium Sulfate - Liquid, Ground or Lump. ANSI/AWWA B403-88, AWWA, 1988.

Drinking-Water Standards for New Zealand. Ministry of Health, Wellington. 1995.

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Standard Methods for the Examination of Water and Wastewater. 19th Ed. APHA, AWWA, WEF, 1995.