

Engineering Standard

SAES-A-208

29 October, 2003

Water Treatment Chemicals

Materials and Corrosion Control Standards Committee Members

Al-Anezi, Mohammed A., Chairman

Al-Rumaih, Abdullah .M., Vice Chairman

Abdulhadi, Abdullatif I.

Al-Anizi, Salamah S.

Al-Gahtani, Moraya S.

Al-Ghasham, Tawfiq Y.

Al-Ismail, Abdulmajid A.

Al-Mugbel, Wajdi M.

Al-Nabulsi, Khalid M.

Al-Sannaa, Muhsen S.

Balhareth, Nasser M.

Bash, Fahad M.

Burgess, Brian W.

Choi, Ho J.

Cruz, Ivan C.

Dias, Olavo C.

Jones, Stan B.

Kermad, Abdelhak

Lobley, Graham R.

Mehdi, Maayed S.

Moore, Mark A.

Morrow, Michael J.

Palmer, Robert E.

Stark, Gregory D.

Tems, Robin D.

Saudi Aramco DeskTop Standards

Table of Contents

1	Scope.....	2
2	Conflicts and Deviations.....	2
3	References.....	2
4	Definitions and Acronyms.....	3
5	Responsibilities.....	5
6	Qualification of New Water Treatment Chemicals.....	7
7	Approved Water Treatment Chemicals.....	8
8	Quality Assurance and Quality Control.....	9
9	Purchase of First-Fill Chemicals.....	11
10	Procurement (See Figure 1).....	12
11	Vendors of Water Treatment Chemicals.....	12

1 Scope

This standard establishes requirements for selection, quality assurance, quality control, and first-fill purchase of water treatment chemicals in Materials Service Group 147000 in materials Supply Inventory. The purpose of this standard is to implement a program that results in the cost-effective purchase and performance of water treatment chemicals. This document does not address other chemicals, such as drilling chemicals, oil field chemicals, Laboratory Chemicals, or chemicals used in refinery processes.

2 Conflicts and Deviations

- 2.1 Any conflicts between this standard and other applicable Saudi Aramco Engineering Standards (SAESs), Materials System Specifications (SAMSSs), Standard Drawings (SASDs), or industry standards, codes, and forms shall be resolved in writing by the Company or Buyer Representative through the Manager, Consulting Services Department of Saudi Aramco, Dhahran.
- 2.2 Direct all requests to deviate from this standard in writing to the Company or Buyer Representative, who shall follow internal company procedure [SAEP-302](#) and forward such requests to the Manager, Consulting Services Department of Saudi Aramco, Dhahran.

3 References

The procedures and test methods covered by this standard shall comply with the latest edition of the references listed below, unless otherwise noted.

3.1 Saudi Aramco References

Saudi Aramco Engineering Procedure

[SAEP-302](#)

*Instructions for Obtaining a Waiver of a
Mandatory Saudi Aramco Engineering
Requirement*

Saudi Aramco Forms

Form 1149

Used for Materials Cataloging (New SAMS Item)

Supply Chain Management Manual

CU 05.02

Material Master

CU 18.01

Claims Against Vendor

3.2 Industry Codes and Standards

American Society for Testing and Materials (ASTM)

ASTM G 96 Standard Guide for the on-line Monitoring of Corrosion and Plant Equipment

American Water Works Association

AWWA M-46 Reverse Osmosis & Nonfiltration

Cooling Technology Institute

Bulletin WTP-30 Guidelines for the Evaluation of Cooling Water Treatment Effectiveness

National Association of Corrosion Engineers (NACE International)

NACE TM0374 Laboratory Screening Tests to Determine the Ability of Scale Inhibitors to Prevent the Precipitation of Calcium Sulfate and Calcium Carbonate from Solution

NACE RP0300 Pilot Scale Evaluation of Corrosion and Scale Control Additives for Open Recirculating Cooling Water Systems

4 Definitions and Acronyms

Responsible Material Control Analyst: The analyst, along with Purchasing, who is responsible for implementing and maintaining the issue restriction system and the phase-in/phase-out of new water treatment chemicals in materials group 147000.

Chemical Quality Assurance Unit (CQAU): The unit within R&D Center responsible for the QA/QC testing of (among others) water treatment chemicals in Materials Service Group 147000 in Materials Supply Inventory

Delivery samples: are obtained from every shipment for QC testing. If the actual delivery sample compares to the pre-delivery retained sample within prescribed limits, the Chemical Quality Assurance Unit approves it. The shipment is released for field delivery and paperwork is stamped, authorizing Accounts Payable to proceed with payment for the shipment. See definitions below for *Pre-Delivery Samples* and for *Retained Standard Sample*.

GAB: General Aerobic Bacteria.

R&D Center: The Research and Development Center.

SRB: Sulfate Reducing Bacteria.

Water treatment chemicals (WTCs): are the water treatment chemicals in Materials Service Group 147000 in Materials Supply Inventory. These chemicals are corrosion inhibitors, scale inhibitors, coagulant aids, flocculants, and biocides.

Water Treatment Chemicals Working Group (WTCWG): a group commissioned by Engineering Services to review all aspects of water treatment chemical selection and procurement. Its charter is to ensure the cost-effective purchase and service performance of water treatment chemicals in Materials Service Group 147000 in Materials Supply Inventory through appropriate specifications and QA/QC procedures.

Performance Testing Protocol: A procedure defining the test or tests to be performed on a particular chemical or group of chemicals to qualify them as acceptable for use in a certain service and for potential plant/field trial.

Performance Factor: a number assigned to a chemical and provided to Purchasing for development of commercial bids. It is calculated as the ratio of the required treatment rate of a chemical determined during plant/field trials, to the treatment rate of the chemical exhibiting the lowest effective treatment rate. For example, corrosion inhibitor A is added at a concentration of 5 ppm to give an acceptable mild steel corrosion rate of 3 mpy. Inhibitor B has to be added to a level of 10 ppm to give the same corrosion rate. The performance factor of inhibitor A is 1, while the performance factor of inhibitor B is 2.

Plant Trial (also called a "field trial"): the use of a new chemical in a plant, to establish its effectiveness and performance factor. Unless results show that the water treatment chemical(s) is ineffective, the duration of the plant/field trial, depending on the nature of the equipment, shall normally be from three months to a maximum of 12 months. Field trial periods should be agreed upon among CSD, Plant Engineering & Operations and the water treatment vendor, prior to initiation of the trial.

Pilot Plant Testing: Testing of a water treatment chemical, in a plant, but using small scale field installed equipment, usually as a side stream installation from the existing process streams.

Pre-delivery Samples: are taken by laboratory personnel from the plant/field trial shipment of a chemical prior to delivery. Pre-delivery samples are required for all new water treatment chemicals, which could later be included in materials group 147000. These samples are retained and become the standard for future QA/QC benchmark testing of future shipments.

QA/QC (Quality Assurance/Quality Control): In the context of this standard, QA generally includes the CSD, Standardization, and RSA functions, as well as matters

relating to selection, screening, performance testing, and trials of chemicals. QC is addressed primarily by the testing of delivery samples.

Qualification Testing: testing in accordance with Section 6 to determine the effectiveness of a chemical in prescribed laboratory evaluations, with the intent to select the best possible candidates for plant/field trials.

Standard Sample: If applicable, CQAU will retain a reference sample of each water treatment chemical cataloged by Saudi Aramco. The Quality Assurance tests and performance analysis of future shipments will be compared to the reference standard.

RSA: the Responsible Standardization Agent for water treatment chemicals in Materials Service Group 147000 in materials Supply Inventory, assigned by Engineering Services/R&D Center, the responsible agency, with the concurrence of Materials Standardization, to be the technical authority on issues related to water treatment chemicals in Materials Service Group 147000 in Materials Supply Inventory. (See Supply Chain Management Manual CU 05.02 Material Master.)

Commentary Note:

The name and telephone number for the RSA can be obtained from Materials Standardization or from DeskTop Standards – Other Information: "RSA Specialists to be Contacted on Matters of Materials Standardization, Stock Simplification, and Source Development."

Standardization Engineer: the Materials Standardization Division engineer responsible for the cataloging of new water treatment chemicals in Materials Service Group 147000 in Materials Supply Inventory, and the maintenance of the Materials Supply Inventory catalog.

5 Responsibilities

5.1 RSA

The RSA is consulted by the Materials Standardization Division and proponents on matters of materials standardization, stock simplification, and source development for water treatment chemicals in Materials Service Group 147000 in Materials Supply Inventory. He is also to be consulted on QA/QC procedures and the cataloging of new water treatment chemicals in Materials Service Group 147000 in Materials Supply Inventory. The RSA has all of the responsibilities listed in Supply Chain Management Manual CU 05.02, plus those contained in this SAES.

5.2 Consulting Services Department (CSD)

The single-point contact for consultation and standards issues related to the use of industrial water treatment chemicals for new projects. CSD will coordinate screening and testing of chemicals for field engineers. Maintains standards and specifications, including this standard.

5.3 Environmental Protection Department

The single-point contact for consultation and standards issues related to the use of waste water treatment chemicals. Issues Chemical Hazard Bulletins (CHB) for any new chemicals

5.4 R&D Center and Area Labs

R&D Center: RSA function, QA/QC, including primary screening and testing.
Area Labs: Field support during plant trials.

5.5 Materials Standardization Engineer

Cataloging and catalog maintenance of water treatment chemicals in Materials Service Group 147000 in Materials Supply Inventory. Consults with the RSA & CSD on issues referenced in this standard and on other technical matters.

5.6 Water Treatment Chemicals Working Group

Establishes appropriate and realistic specifications and QA/QC procedures for WTCs to enable the cost-effective procurement by operating units. Maintain Water Treatment Chemicals Standard.

5.7 Operations Engineering Units

Field/plant trials of WTCs, tracking of use, determination of competitive equivalents, technical qualification for use, and determination of performance factors.

5.8 Project Management

Responsible for first-time fill of WTC tanks. Work with Operations, Operations Engineering, Purchasing, CQAU and CSD to ensure that suitable, cost-effective chemicals are specified and purchased for the project.

5.9 Purchasing Department, Buyer of water treatment chemicals in Materials Service Group 147000 in Materials Supply Inventory. Single point contact with vendors and users for all commercial considerations. Develops competitive bids

and notifies Operations and Operations Engineering of the most cost-effective chemicals for use.

6 Qualification of New Water Treatment Chemicals

6.1 Protocol for the selection and qualification of new water treatment chemicals (Figure 1.)

6.1.1 Sample Submission

RSA shall normally restrict the number of samples to a maximum of two per vendor for each potential application category (corrosion inhibitor, scale inhibitor, etc.)

6.1.2. Testing shall be carried out using parameters closely simulating field conditions, as agreed in writing among the coordinating engineer, the end-user, and the appropriate testing laboratory in writing, with one copy to the RSA, one copy to Purchasing, and one copy to the Chairman of the Water Treatment Chemicals Working Group.

6.1.3 In addition to establishing the Quality Assurance tests for a chemical by the Chemical Quality Assurance Unit, LR&DC, Dhahran, an appropriate selection, "Performance Testing Protocol", from the test methods shown below and summarized in Table 1 to determine relevant parameters shall be performed by the laboratory unit designated in paragraph 5.4 above, following agreement with the requesting organization:

NOTES: *For corrosion inhibitors (Corrosion Services Unit/R&DC): Tests can include, but are not limited to, the following techniques:*

- i) Electrochemical techniques: Linear polarization, impedance and noise.*
- ii) Phase partitioning – aqueous phase inhibitor concentration, corrosion mitigation of partitioned aqueous phase.*
- iii) Weight loss techniques – autoclave, wheel oven.*
- iv) Electrical resistance (gas phase).*

For calcium sulfate and calcium carbonate scale inhibitors (Formation Damage & Stimulation Unit/R&DC): NACE TM0374 (latest revision.)

Biocides (Petroleum Microbiology Unit/R&DC): SRB & GAB kill tests using serial dilution or enumeration techniques.

Neutralizing amines can be tested by titration with a mineral acid to determine the pKb value of the amine.

In all cases, other tests may also be deemed suitable, and can be included in the testing protocol at the discretion of R&DC, CSD, or the proponent Operations Engineering organization.

6.2 Pre Delivery Samples Plant/Field Trial

- 6.2.1 All relevant information concerning the water treatment chemicals to be tested, including product data sheets and materials safety data sheets shall be supplied to the RSA for water treatment chemicals in Materials Service Group 147000 in Materials Supply Inventory.
- 6.2.2 The vendor shall route the plant/field trial chemical shipment to the Chemical Quality Assurance Unit for collection of the pre-delivery sample at least 5 working days prior to the start of the plant/field trial.
- 6.2.3 Unless informed by the vendor that the chemical has a finite shelf life, the Chemical Quality Assurance Unit shall retain all samples of chemicals qualified for use by a successful plant trial until the Materials Group 147000 RSA authorizes disposal. This will normally occur only after the Water Treatment Chemicals Working Group through Standardization officially certifies a chemical obsolete.

7 Approved Water Treatment Chemicals

- 7.1 If a chemical successfully passes a plant/field trial and the responsible plant engineer considers it a candidate for regular use, the responsible plant engineer shall notify his areas representative (or the Chairman of the WTCWG) to the Water Treatment Chemicals Working Group in writing, with a copy to purchasing, that it has successfully passed the test and confirming that cataloging has been requested. The notification and the request for cataloging shall contain the results of the plant/field trial and the performance factor generated from that trial. All correspondence with the WTCWG should be attached to the appropriate 1149 form.
- 7.2 A product can be added to the list of approved water treatment chemicals after a member of the Water Treatment Chemicals Working Group is notified in writing that the product has successfully passed field tests in a Producing facility. It shall be the responsibility of the WTCWG Chairman to request the Materials Group 147000 RSA and the materials group 147000 Buyer to add the chemical to the list, and to notify the WTCWG members of the addition for consideration of use in other producing departments. Whenever the WTCWG identifies the use of a chemical in other facilities, the Materials Group 147000 RSA and the Materials Group 147000 Buyer shall be notified.

- 7.3 The WTCWG shall maintain an up-to-date list of all approved water treatment chemicals and keep the MICA, CQAU, the Standardization Engineer, and the Buyer of water treatment chemicals in Materials Service Group 147000 in Materials Supply Inventory informed of the approved water treatment chemicals.
- 7.4 The Water Treatment Chemicals Working Group shall review the list of approved water treatment field chemicals no less than once a year; identify new catalog items with recommendations for cataloging action; and identify obsolete products with recommendations for their removal from SAMS.
- 7.5 No less than once a year a Utilities Engineer or Operations Engineer from each Department using WTCs shall provide to the WTCWG and to Purchasing the usage of water treatment chemicals in Materials Service Group 147000 in Materials Supply Inventory for his Department or individual Divisions within the Department. This engineer shall be the Producing Department's Operations Engineering representative to the WTCWG.

8 Quality Assurance and Quality Control

8.1 QA/QC Testing

The R&D Center Chemical Quality Assurance Unit/Materials Sciences R&D Division is responsible for the QA/QC testing of every delivery of water treatment chemicals in Materials Service Group 147000 in Materials Supply Inventory.

8.2 Performance testing on delivery samples

Additional testing shall be performed by the R&D Center on randomly picked shipments of Water Treatment chemicals as follows:

8.2.1 Corrosion inhibitors

A Wheel Oven test shall be carried out on the selected delivery sample and on the retained standard sample for the calendar year. Each test shall be performed on ten samples. The mean value for the corrosion rate obtained on the delivery sample must be within 20% of the standard value. If the standard deviation of the test series is greater than 2, the test shall be repeated. If the test results again show that the performance is still not within 20% of the standard value, a full test protocol (identical to the original qualification protocol listed in Section 6) shall be conducted.

8.2.2 Neutralizing Amines

Neutralizing amines shall be tested for basicity (pK_b) by titration with 0.01 M HCl. Results should be compared to the retained sample obtained from the plant/field trial.

8.2.3 Calcium sulfate or calcium carbonate scale inhibitors

The NACE TM0374 (latest revision) test method shall be carried out in triplicate on the delivery sample, the retained standard, and a blank solution. Inhibitor effectiveness shall be determined from the calcium concentration remaining in solution.

8.2.4 Non-Oxidizing Biocides

Random delivery samples shall be taken and tested for their ability to control SRB or GAB activity. Results shall be compared to the results obtained from initial tests of the retained biocide standard.

8.3 Requests for testing can be initiated by CSD, Materials Standardization Organization (MSO), Operations Engineering organizations, Producing Operations, other Departments using WTCs, or the Water Treatment Chemicals Working Group through the RSA.

8.4 Actions upon failure of the QC tests

8.4.1 In the event that a routine delivery sample of a water treatment chemical fails QC testing, stipulated additional testing shall be carried out.

8.4.2 In the event that a randomly taken sample of a water treatment chemical should fail the additional tests, full performance tests shall be carried out in accordance with the methods used for the selection process of new chemicals.

8.4.3 CQAU shall inform the end user that a chemical scheduled for delivery to their location has failed the QA/QC testing and ask for approval to release the shipment for use or to reject the shipment for remediation, if possible or formulation of a new shipment if not. CQAU shall inform the end user of the parameter(s) which failed the testing in order for the end user to make an informed decision to accept or reject the shipment.

The end user must be allowed to accept the failed chemical after consideration of the consequences of the use of the non-compliant product.

- 8.4.4 The RSA shall inform purchasing and the vendor of out-of-specification WTC's.
- 8.4.5 Repeated failures of a chemical to pass routine QC tests shall result in the vendor being notified that this particular chemical shall be removed from the Aramco system. If the chemical still fails QC tests, the RSA shall notify Material Control Department to initiate action to remove the vendor from the approved suppliers list.
- 8.5 In the event a chemical does not meet the item description or specification, the end user may consider initiation of possible claims action through the receiving storehouse per the Materials Instruction Manual Claims Procedure Form CU 18.01.
- 8.6 Delivery
- Delivery to the DPC (Delivery Point Center) shall proceed only after the appropriate QA/QC tests are finished and the material is certified as suitable for use.

9 Purchase of First-Fill Chemicals

- 9.1 In capital projects where water treatment chemicals in Materials Service Group 147000 in Materials Supply Inventory such as corrosion inhibitors, scale inhibitors, anti-foams, biocides, or neutralizers, are to be used, the LSTK (Lump Sum Turnkey) contractor shall be responsible for the following:
- The purchase of the "first fill" of all such chemicals, and coordination with CQAU for QA/QC requirements.
 - For ensuring the cleanliness and mechanical operation of the chemical injection systems as designed.
- 9.2 The specification and selection of the chemical(s) shall be the responsibility of the operating organization, with concurrence of CSD/ME&CCD, and Purchasing.
- 9.3 PMT shall provide the operating organization, CSD/ME&CCD, and Purchasing with adequate time and information needed to make the chemical selection. In no case shall this be less than six (6) months prior to the date the project is scheduled to start operation.

10 Procurement (See Figure 1)

- 10.1 Figure 1 shall be used as the protocol to follow in the procurement process for water treatment chemicals in Materials Service Group 147000 in Materials Supply Inventory.
- 10.2 Contact the RSA and the Standardization Engineer to resolve technical issues related to Standardization. The RSA may give written approval for substitution of chemicals with equivalent characteristics and performance. Deviations that do not provide equivalent performance require waiver approval in accordance with [SAEP-302](#) before issuance of a Purchase Order. For deviations identified after a Purchase Order is issued, the waiver approval is required prior to shipment.
- 10.3 Contact the Purchasing Department Buyer for water treatment chemicals in Materials Service Group 147000 in Materials Supply Inventory to resolve problems with delivery from vendors.
- 10.4 Contact the Chemical Quality Assurance Unit/R&D Center to address QA/QC problems.
- 10.5 Contact Material Control to resolve issue restriction and phase-in/phase-out procedures.

11 Vendors of Water Treatment Chemicals

11.1 Vendor qualification

Saudi Aramco has an established procedure for the qualification of new vendors through the Industrial Development Division (IDD)/Saudi Aramco Affairs. If in doubt, contact them to determine if a chemical vendor has already been approved. Any approved vendor must be able to supply the minimum following service requirements.

1. Vendor to perform lab analysis of the important chemical parameters to ensure they are in the control limits.
 2. Vendor to discuss the results with both Operations and Engineering to recommend an Action Plan for parameters out of limits.
 3. Vendor to provide supervision of on-line monitoring equipment that measures treatment parameters.
 4. Vendor to provide inspection service reports on the condition of the equipment being treated (usually during a T&I).
 5. Vendor to provide inventory checks on the treatment chemical stock at the plant site.
-

6. Vendor to monitor the chemical injection system.
7. Vendor to recommend improvements or modifications that can enhance the treatment.
8. The vendor will have the capability of providing non-routine lab tests that will ensure proper treatment, for example:
 - Scale Density Index boiler tube results
 - Deposit and water analyses
 - Bioassays
 - Metallographic Failure Analyses

NOTES: *The non-routine analyses may be free of charge or may have a direct charge for them, depending on the vendor and the size of the account. The frequency of the technical service visits will depend upon the vendor and the size of the account*

11.2 Restricted vendor list

Consult the Purchasing Department Buyer for water treatment chemicals in Materials Service Group 147000 in Materials Supply Inventory for this information.

11.3 Vendor-provided test data

The vendor shall provide, at the request of a Saudi Aramco engineer or scientist, independent laboratory test data, internal laboratory test data, or field case histories to support his claims for the performance of any product that he may request Saudi Aramco to evaluate for its use.

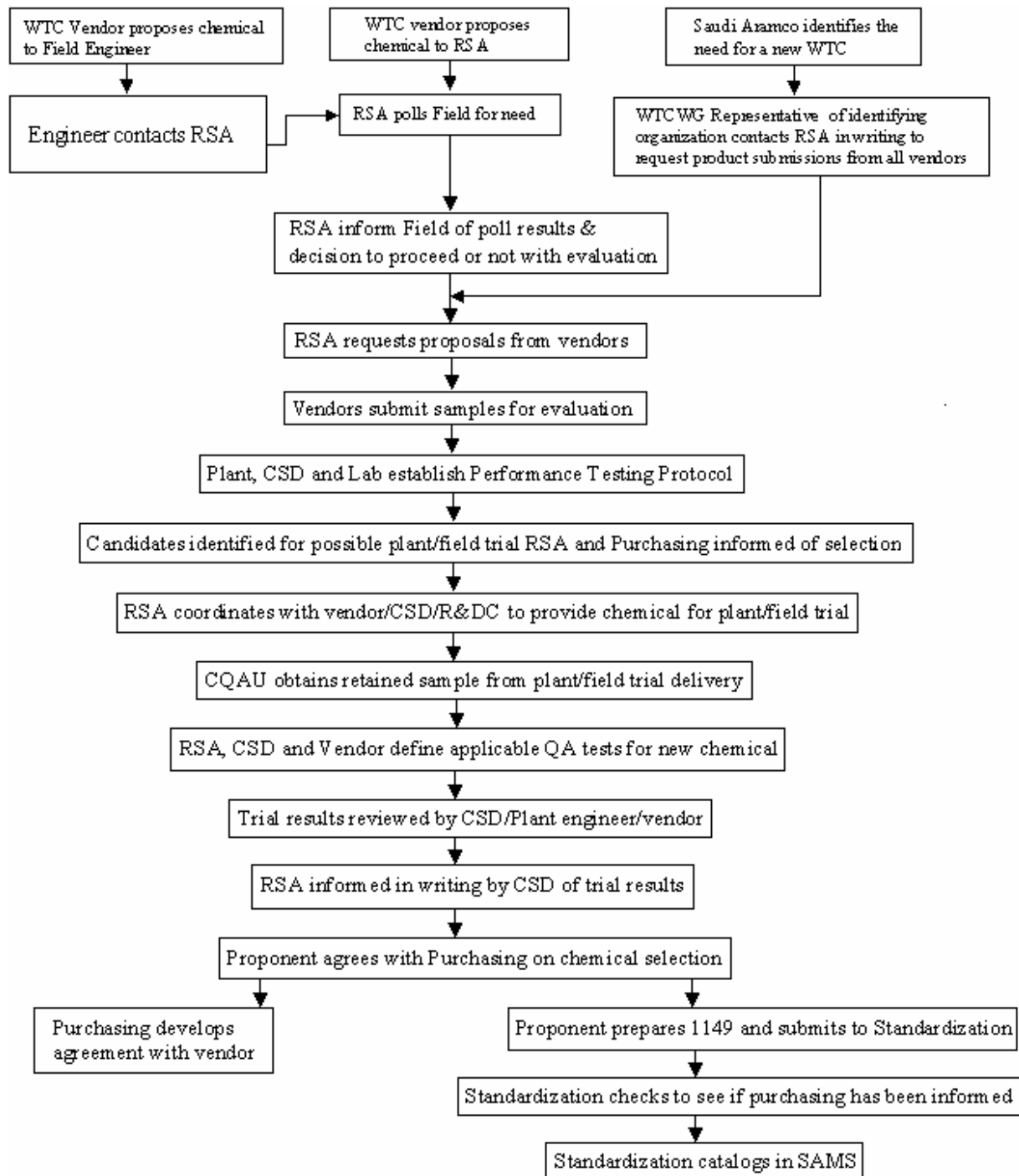


Figure 1. Protocol for the Selection and Qualification of New Water Treatment Chemicals

Table 1. Testing Required for Approval of New Water Treatment Chemicals

Equipment	Chemical Type	Test Type
Boiler	Scale Inhibitor	Field Test
	Corrosion inhibitor	Field Test
	Oxygen Scavenger	Field Test
	Neutralizing Amine	Field Test/lab test
	Antifoam	Field Test
Cooling Systems	Scale Inhibitor	Lab Test; NACE TM0374 (latest revision) Pilot Plant Testing, NACE RP0300 - 2000 Field Test, CTI WTP-30
	Corrosion Inhibitor	Lab Test Pilot Plant Testing, NACE RP0300 - 2000 Field Test, CTI WTP-30 ¹
	Biocide	Lab Test. Kill tests using serial dilution or enumeration techniques
Membrane Desalination (RO/ED)	Scale Inhibitor	NACE TM0374/Pilot Plant Tests, See AWWA M-46
	Membrane preservatives	
	Biocides	Lab Test. Kill tests using serial dilution or enumeration techniques
	Cleaning Agents	Field Test
	Sulfuric acid	Lab Test
	Cleaning Agents	Pilot Plant Tests
Filters	Coagulant Aids	Jar Tests, followed by pilot plant filterability study
	Flocculants	Jar Tests, followed by pilot plant filterability study
Thermal Desalination (MSF/MED/VC)	Scale Inhibitors	Field Test
	Antifoam	Field Test
	Chlorine scavengers	Lab Testing

Note:

¹ Tests can include (but are not limited to) Electrochemical Techniques – Linear Polarization Resistance Impedance & Noise. Weight Loss techniques such as the wheel oven.

Table 2. Water Treatment Chemicals Working Group

A. D. Al-Majnouni, Chairman	874-7975	CSD
M. A. Moore (Vice Chairman)	874-7340	CSD
A. H. Balubaid	285-1883	RRD
Y. Al-Dukhayyil (Water treatment chemicals in Materials Service Group 147000 in materials Supply Inventory RSA)	872-2934	R&DC
A.M. Al-Zawad	673-4776	RTR
C. W. Brown	577-5971	UGP
H. K. Mahroos	872-0850	DUD
A. M. Al-Qahtani	872-3293	R&DC
H. Sanmugam	874-0634	STDZ
T. A. Owen	874-0036	Purchasing
S. A. Al-Ghamdi	874-0632	STDZ

29 October, 2003

Revision Summary
New Saudi Aramco Engineering Standard.