

**Domain**

**WATER SUPPLY AND SANITATION  
OPERATIONS**

**Title:**

**Demonstrate the application of  
advanced chemistry in water supply**

**Level: 3**

**Credits: 8**

**Purpose**

This unit standard is intended for Technicians in the Water Supply and Sanitation Sector. People credited with this unit standard will be able to:

- Describe terms and application in advanced chemistry
- Carry out sewage strength calculations
- Carry out chemical formulae and balanced reaction calculations
- Understand the chemistry of polymerisation
- Define the term catalysis
- Define combustion

**Special Notes**

1. Entry information

Prerequisite:

- *Unit 1804 Demonstrate application of basic chemistry in water supply and sanitation*
- *Unit 1806 Carry out routine laboratory tests*

2. This unit standard should be delivered and assessed in the context of the water supply and sanitation sector operations and be further assessed in conjunction with other relevant technical units selected from this domain.
3. The evidence required to demonstrate competency in this unit must be relevant to workplace operations
4. All inspection, operation and maintenance procedures associated with the use of tools and equipment shall comply with manufacturers' guidelines and instructions.
5. Glossary of terms  
'*Coking*' refers to production of 'coke', a carbon fuel produced by distillation of coal.  
'*Combustion*' refers to a chemical reaction that occurs between a fuel and an oxidizing agent that produces energy, usually in the form of heat and light.  
'*Polymerisation*' means a chemical process that combines several monomers to form a polymer or polymeric compound.

6. Regulations and legislation relevant to this unit standard include the following:

- Water Resources Management Act, 2013 (Act No.11 of 2013).
- Labour Act No. 11 of 2007 in conjunction with Regulation 156, 'Regulations Relating to the Health and Safety of Employees at work'.
- Environmental Management Act, 2007 (Act No. 7 of 2007).
- Namibian Water Quality Standards.

### **Quality Assurance Requirements**

This unit standard and others within this subfield may be awarded by institutions which meet the accreditation requirements set by the Namibia Qualifications Authority and the Namibia Training Authority and which comply with the national assessment and moderation requirements. Details of specific accreditation requirements and the national assessment arrangements are available from the Namibia Qualifications Authority and the Namibia Training Authority on [www.nta.com.na](http://www.nta.com.na).

### **Elements and Performance Criteria**

#### **Element 1: Describe terms and application in advanced chemistry**

##### **Range**

Advanced chemical terms used to operate water and sewage treatment plants are included.

##### **Performance Criteria**

- 1.1 Specific terms, such as polymers, monomers and isomers are explained.
- 1.2 Solubility of gases in liquids and effect of temperature and pressure on equilibrium is identified and described.
- 1.3 The difference between organic and inorganic compounds (matter) is described.
- 1.4 Cations and anions occurring in water are identified.
- 1.5 The terms 'oxidation' and 'reduction' are defined and their reactions written.
- 1.6 Alkalinity, buffer capacity and absorption are described.
- 1.7 Uses of activated carbon are identified.
- 1.8 Concentration of chemical reactions and mole versus normality is explained and calculated.

## **Element 2: Carry out sewage strength calculations**

### **Range**

Sewage strength includes oxygen absorption, chemical oxygen demand and total oxygen carbon.

### **Performance Criteria**

- 2.1 Sewage strength is defined based on oxygen absorbed and chemical oxygen demand.
- 2.2 Basic reactions where all organic substances containing carbon, hydrogen and nitrogen which can be oxidised in sewage treatment are written.
- 2.3 Tests are undertaken to measure the oxygen demand (oxygen necessary to oxidise organic substances) and their ratio calculated.
- 2.4 Parameters used to determine the “strength” of sewage water is identified.

## **Element 3: Carry out chemical formulae and balanced reaction calculations**

### **Range**

Balanced reaction equations of chemicals used in water and sewage treatment plants are included.

### **Performance Criteria**

- 3.1 Complex chemical formulae are written from basic knowledge of the periodic table.
- 3.2 The valencies of the groups in the periodic table are identified.
- 3.3 The formulae of compound ions, their charges and valencies are identified and written.
- 3.4 Formulae are written using compound ions.
- 3.5 Balanced reaction equations of chemicals used in water and sewage treatment plants are written.
- 3.6 The ratios of the reactants are calculated.

## **Element 4: Understand the chemistry of polymerisation**

### **Range**

Conditions which are used for practical polymerisation include electrical and mechanical properties.

### **Performance Criteria**

- 4.1 Difference between molecules and polymers are identified.
- 4.2 Co-polymerisation and polymerisation is differentiated.
- 4.3 The ways in which polymers are formed is described
- 4.4 Main groups into which polymers are divided are described, according to their origin, composition and characteristics.
- 4.5 Two basic conditions which are used for practical polymerisation are identified and discussed.
- 4.6 Structures of polystyrene, such as teflon, cellulose, polybutadiene, are drawn.
- 4.7 The practical operational use of polymers in water and sewage treatment plants is explained and demonstrated.

## **Element 5: Define the term catalysis**

### **Range**

All terms are defined and their use in water and sanitation operations explained.

### **Performance Criteria**

- 5.1 The term catalyst is defined and its use in water and sanitation operations explained.
- 5.2 The term promoter action for catalysts is understood and its use in water supply and sanitation operations explained.
- 5.3 The term cracking is defined and its use in water supply and sanitation operations explained.
- 5.4 The terms hydrogenation and dehydrogenation are differentiated.
- 5.5 The term synthesis is defined and its use in water supply and sanitation operations explained.

## **Element 6: Define combustion and its application in water and sanitation operations**

### **Range**

Combustion theory is included with the place of heat, oxygen and steam given.

### **Performance Criteria**

- 6.1 The term combustion is defined and its use in water and sanitation operations explained.
- 6.2 Generation of heat in boilers is explained.
- 6.3 A bomb calorimeter is illustrated by means of a sketch.
- 6.4 The role of oxygen in combustion is explained.
- 6.5 Calculations by mass balance are explained.
- 6.6 The generation of steam is explained in terms of water tube boilers and fire tube boilers.
- 6.7 The heat required to generate wet steam is calculated.
- 6.8 Data is recorded and filed.

### **Registration Data**

<b>Field:</b>	Physical Planning and Construction
<b>Subfield:</b>	Water Supply and Sanitation
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<b>Anticipated review:</b>	2023
<b>Body responsible for review:</b>	Namibia Training Authority