

<b>Title</b>	<b>Manufacture sodium hydroxide and chlorine products for pulp bleaching</b>		
<b>Level</b>	<b>5</b>	<b>Credits</b>	<b>30</b>

<b>Purpose</b>	<p>People credited with this unit standard are able to: explain fundamentals of sodium hydroxide and chlorine, liquid chlorine, hydrochloric acid, and sodium hypochlorite manufacture; efficiently operate and maintain sodium hydroxide and chlorine, hydrochloric acid, and liquid chlorine manufacturing plants; monitor and control the efficient performance of a sodium hydroxide and chlorine, a liquid chlorine, and a hydrochloric acid manufacturing plant; and operate and maintain equipment, and monitor and control efficient performances of processes and equipment for sodium hypochlorite manufacture.</p>
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<b>Classification</b>	Wood Fibre Manufacturing > Pulp and Paper - Chemical Plants
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<b>Available grade</b>	Achieved
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## Guidance Information

### 1 Definition

*Worksite documentation* refers to instructions to staff on policy and procedures (including the application of legislation to worksite situations) which are formally documented, and are available for reference at the worksite. Examples are standard operating procedures, specifications, manuals, and manufacturer's information.

### 2 The following apply to the performance of all outcomes of this unit standard:

- a All work practices must meet recognised codes of practice and documented worksite health and safety and environmental procedures (where these exceed code) for personal, product, and worksite health and safety, and must meet the obligations required under current legislation, including the Health and Safety in Employment Act 1992, the Resource Management Act 1991, the Hazardous Substances and New Organisms Act 1996, and their subsequent amendments.
- b All work practices must meet documented worksite operating procedures. This includes the recording (by electronic or non-electronic means) of activities, events, and decisions.
- c All communications made in relation to this unit standard must be made in accordance with worksite procedures for content, recipient, timing, and method.

## Outcomes and performance criteria

### Outcome 1

Explain fundamentals of sodium hydroxide and chlorine manufacture.

**Performance criteria**

- 1.1 Operating principles of sodium hydroxide and chlorine manufacturing plant are explained in accordance with worksite documentation.
- Range electrolysis, chemical reaction, membrane integrity, purification of gas streams.
- 1.2 Operating parameters and capability of sodium hydroxide and chlorine manufacturing plant are explained in accordance with worksite documentation.
- Range temperatures, pressures, purity, sodium hydroxide concentrations, hydrogen concentration, pH, electrical current, voltage, demineralised water, brine purity, concentration.
- 1.3 Operating components and process controls of sodium hydroxide and chlorine manufacturing plant are identified, and their purpose is explained, in accordance with worksite documentation.
- Range operating components may include but are not limited to – anolyte system, catholyte system, nitrogen purge system, hydrogen handling system, rectifier, transformer, hydraulic pressure system.
- 1.4 Hazards associated with operating the sodium hydroxide and chlorine manufacturing plant are identified and actions to be taken to isolate, minimise, or eliminate the hazard are described in accordance with worksite documentation.
- Range hazards may include but are not limited to – bursting disc, ruptured hoses, membrane failure, hydrogen leaks, chlorine leaks, power failures, failure of nitrogen system, hydraulic system failure, gasket failure.

**Outcome 2**

Explain fundamentals of liquid chlorine manufacture.

**Performance criteria**

- 2.1 Operating principles of liquid chlorine manufacturing plant are explained in accordance with worksite documentation.
- Range moisture removal, compression, condensation, pressurisation, removal of non-condensable gases.
- 2.2 Operating parameters and capability of liquid chlorine manufacturing plant are explained in accordance with worksite documentation.
- Range pressures, temperature, moisture content, gas ratios.

2.3 Operating components and process controls of liquid chlorine manufacturing plant are identified, and their purpose is explained, in accordance with worksite documentation.

Range components may include but are not limited to – acid dryers, separator, compressors, refrigeration system, condensers, equalising lines, storage tanks and scrubbing system, dry air system, safety system, sniff system, fans.

2.4 Hazards associated with operating the liquid chlorine manufacture plant are identified and actions to be taken to isolate, minimise, or eliminate the hazard are described in accordance with worksite documentation.

Range hazards may include but are not limited to – blown bursting disc, broken lines, overfilled tanks, acid leaks, gas leaks, corrosion, ammonia, chlorine leaks, hydrochloric acid fumes, sodium hydroxide leaks, hydrogen leaks.

### Outcome 3

Explain fundamentals of hydrochloric acid manufacture.

#### Performance criteria

3.1 Operating principles of hydrochloric acid manufacturing plant are explained in accordance with worksite documentation.

Range hydrogen-oxygen-chlorine explosion triangle, cooling, reactions, absorbance of chlorine, vacuum and pressure controls, purging system.

3.2 Operating parameters and capability of hydrochloric acid manufacturing plant are explained in accordance with worksite documentation.

Range parameters may include but are not limited to – density, flows, gas ratios, temperatures.

3.3 Operating components and process controls of hydrochloric acid manufacturing plant are identified, and their purpose is explained, in accordance with worksite documentation.

Range operating components may include but are not limited to – furnace, after absorber, flame arresters, nitrogen purge system, steam ejector or fan, hydrogen separator, hydrogen cooler.

3.4 Hazards associated with hydrochloric acid manufacture are identified and actions to be taken to isolate, minimise, or eliminate the hazard are described in accordance with worksite documentation.

Range hazards may include but are not limited to – ruptured bursting disc and hydrogen leaks, chlorine leaks, hydrochloric acid burns, explosions.

**Outcome 4**

Explain fundamentals of sodium hypochlorite manufacture.

**Performance criteria**

- 4.1 Operating principles of sodium hypochlorite manufacturing plant are explained in accordance with worksite documentation.
- Range vacuum control, counter current flows, chemical reactions, oxidation-reduction potentials.
- 4.2 Operating parameters and capability of the sodium hypochlorite manufacturing plant are explained in accordance with worksite documentation.
- Range vacuum, temperature, levels, oxidation-reduction potential.
- 4.3 Operating components and process controls of the sodium hypochlorite manufacturing plant are identified, and their purpose and operation are explained, in accordance with worksite documentation.
- Range operating components include but are not limited to – hypo reactors, coolers, ejectors, scrubber tower, distributed control system.
- 4.4 Hazards associated with sodium hypochlorite manufacture are identified and actions to be taken to isolate, minimise, or eliminate the hazard are described in accordance with worksite documentation.
- Range physical hazards may include but are not limited to – blocked coolers, blocked ejectors, blocked scrubbers, leakages, vacuum loss.
- 4.5 Hazards associated with chemicals used in the manufacture of sodium hypochlorite are identified, and management of risks is explained, in accordance with worksite documentation.
- Range chemicals may include – caustic, chlorine gas, chlorate, sodium hypochlorite.

**Outcome 5**

Operate and maintain a sodium hydroxide and chlorine manufacturing plant efficiently.

**Performance criteria**

- 5.1 Safe work practices associated with operating a sodium hydroxide and chlorine manufacturing plant are identified and used in accordance with worksite documentation and legislative requirements.
- Range practices may include but are not limited to – plant entry procedures, isolation procedures, lock-outs, emergency stops, machine guarding, area alert and site alert systems, wearing appropriate safety equipment.
- 5.2 Sodium hydroxide and chlorine manufacturing plant is operated, and shut down efficiently in accordance with worksite documentation.
- 5.3 Chemicals are assembled in accordance with worksite documentation.
- 5.4 Setting and timely adjustment of operating parameters enables production requirements to be achieved in accordance with worksite documentation.
- Range operating parameters – current, temperatures, chemical concentrations, pressures, flows, pH, input chemical purity, voltage, membranes;  
production requirements – gas and chemical purity, chemical strength, production rate.
- 5.5 Preventative maintenance and cleaning requirements are carried out in accordance with worksite documentation.

**Outcome 6**

Monitor and control the efficient performance of a sodium hydroxide and chlorine manufacturing plant.

**Performance criteria**

- 6.1 Monitoring and interpretation of feedback information and the timely adjustment of control parameters enable product quality, efficient plant performance, and process and legislative requirements to be maintained in a sodium hydroxide and chlorine manufacturing plant in accordance with worksite documentation.
- Range control parameters – current, temperatures, concentrations, pressures, flows, acidity, purity, voltage, membranes;  
process requirements – customer demand, storage levels, production priority.

- 6.2 Operating and equipment faults and malfunctions in a sodium hydroxide and chlorine manufacturing plant are identified, and corrective action is taken, in accordance with worksite documentation.
- Range operating faults and malfunctions – blockages, leakages, contamination;  
equipment faults and malfunctions – electrical, mechanical, instrumentation, distributed control system.
- 6.3 Output product meets the requirements of worksite documentation for pressure, temperature, pH, flows, levels, purity, and concentration.
- 6.4 Production, maintenance, and quality records are explained and completed in accordance with worksite documentation.

### **Outcome 7**

Operate and maintain a liquid chlorine manufacturing plant efficiently.

#### **Performance criteria**

- 7.1 Safe work practices associated with operating a liquid chlorine manufacturing plant are identified and used in accordance with worksite documentation and legislative requirements.
- Range practices may include but are not limited to – plant entry procedures, isolation procedures, lock-outs, emergency stops, machine guarding, wearing appropriate safety equipment.
- 7.2 Pre-start up checks are carried out in accordance with worksite documentation.
- Range lubrication, pressure, safety devices.
- 7.3 Compressor is set up, started up, operated and shut down efficiently in accordance with worksite documentation.
- Range pre-warming, dry air purging, establishment of chlorine and water flows, pressures.
- 7.4 Cooling plant systems are operated in accordance with worksite documentation.
- 7.5 Setting and timely adjustment of operating parameters enables production requirements to be achieved in accordance with worksite documentation.
- Range operating parameters – temperatures, concentrations, pressures, flows, purity;  
production requirements – purity, chemical strength, production rate.

- 7.6 Compressor is taken off line in accordance with worksite documentation.
- Range disestablishment of chlorine and water flows, dry air purging, establishment of steam flow, powering off.
- 7.7 Preventative maintenance and cleaning requirements are carried out in accordance with worksite documentation.

### **Outcome 8**

Monitor and control the efficient performance of a liquid chlorine manufacturing plant.

#### **Performance criteria**

- 8.1 Monitoring and interpretation of feedback information and the timely adjustment of control parameters enable product quality, efficient plant performance, and process and legislative requirements to be maintained for a liquid chlorine manufacturing plant in accordance with worksite documentation.
- Range control parameters – temperatures, densities, pressures, flows, purity;  
process requirements – customer demand, storage levels, production priority.
- 8.2 Operating and equipment faults and malfunctions in the liquid chlorine manufacturing plant are identified, and corrective action is taken, in accordance with worksite documentation.
- Range operating faults and malfunctions – leakages, blockages, equipment failure, contamination.
- 8.3 Production, maintenance, and quality records are explained and completed in accordance with worksite documentation.

### **Outcome 9**

Operate and maintain a hydrochloric acid manufacturing plant efficiently.

#### **Performance criteria**

- 9.1 Safe work practices associated with operating a hydrochloric acid manufacturing plant are identified and used in accordance with worksite documentation and legislative requirements.
- Range practices may include but are not limited to – isolation procedures, lock-outs, emergency stops, machine guarding, wearing appropriate safety equipment.
- 9.2 Hydrochloric acid manufacturing plant is set up, started up, operated and shut down efficiently in accordance with worksite documentation.

9.3 Furnace is prepared for lighting in accordance with worksite documentation.

Range purging, valve set-up.

9.4 Flows to furnace are established in accordance with worksite documentation.

Range hydrogen, chlorine, nitrogen, air, steam, water.

9.5 Flames are established in accordance with worksite documentation.

Range wand flame, furnace flame.

9.6 Setting and timely adjustment of operating parameters enables hydrochloric acid production requirements to be achieved in accordance with worksite documentation.

Range operating parameters – temperatures, concentrations, pressures, flows, purity;  
production requirements – purity, chemical strength, production rate.

9.7 Preventative maintenance and cleaning requirements are carried out in accordance with worksite documentation.

### **Outcome 10**

Monitor and control the efficient performance of a hydrochloric acid manufacturing plant.

#### **Performance criteria**

10.1 Monitoring and interpretation of feedback information and the timely adjustment of control parameters enable product quality, efficient plant performance, and process and legislative requirements to be maintained in accordance with worksite documentation.

10.2 Operating and equipment faults and malfunctions in a hydrochloric acid plant are identified, and corrective action is taken, in accordance with worksite documentation.

Range operating faults and malfunctions – bursting disc, gas leaks, ruptures, incorrect ratios, loss of flame, cooling water, absorption water or gas pressure.

10.3 Production, maintenance, and quality records are explained and completed in accordance with worksite documentation.

### **Outcome 11**

Operate and maintain equipment for sodium hypochlorite manufacture efficiently.



**Performance criteria**

- 11.1 Safe work practices associated with operating equipment for sodium hypochlorite manufacture are identified and used in accordance with worksite documentation and legislative requirements.
- Range practices may include but are not limited to – isolation procedures, lock-outs, emergency stops, machine guarding, wearing appropriate safety equipment.
- 11.2 Equipment is set up, started up, operated, and shut down efficiently in accordance with worksite documentation.
- Range equipment may include but is not limited to – hypo tower, fans, circulating pumps and tanks, circulation cooler, product hypo reactor, cooler and storage tank, chlorine sniff system, hypo ejector, filters.
- 11.3 Chemicals are assembled in accordance with worksite documentation.
- 11.4 Setting and timely adjustment of operating parameters enables production requirements to be achieved in accordance with worksite documentation.
- Range operating parameters – temperatures, levels, pressures, flows, strengths and chemical reactions, oxidation-reduction potential; production requirements – purity, chemical strength, production rate.
- 11.5 Preventative maintenance and cleaning requirements are carried out in accordance with worksite documentation.

**Outcome 12**

Monitor and control the efficient performance of process and equipment for sodium hypochlorite manufacture.

**Performance criteria**

- 12.1 Monitoring and interpretation of feedback information and the timely adjustment of control parameters enable product quality, efficient plant performance, and process and legislative requirements to be maintained in accordance with worksite documentation.
- Range control parameters – temperatures, levels, pressures, flows, strengths, oxidation-reduction potential, chemical reactions; process requirements – customer demand, storage levels, production priority.

12.2 Operating and equipment faults and malfunctions in the sodium hypochlorite plant are identified, and corrective action is taken, in accordance with worksite documentation.

Range operating faults and malfunctions may include but are not limited to – off-specification sodium hypochlorite, high oxidation-reduction potential, gas emissions, vacuum loss; equipment faults and malfunctions – electrical, mechanical, instrumentation, distributed control system.

12.3 Output product meets the requirements of worksite documentation for strength and purity.

<b>Replacement information</b>	This unit standard replaced unit standard 15822, unit standard 15824, unit standard 16288, unit standard 16289, unit standard 16290, and unit standard 16291.
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**This unit standard is expiring. Assessment against the standard must take place by the last date for assessment set out below.**

**Status information and last date for assessment for superseded versions**

Process	Version	Date	Last Date for Assessment
Registration	1	18 December 2006	31 December 2025
Review	2	24 October 2014	31 December 2025
Review	3	30 November 2023	31 December 2025

<b>Consent and Moderation Requirements (CMR) reference</b>	0173
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This CMR can be accessed at <http://www.nzqa.govt.nz/framework/search/index.do>.