**NZQA**

**Approved**

Achievement standard: 91163 Version 2

Standard title: Demonstrate understanding of the chemistry used in the development of a current technology

Level: 2

Credits: 3

Resource title: Sticky stuff

Resource reference: Chemistry VP-2.3 v2

Vocational pathway: Construction and Infrastructure

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| Quality assurance status | These materials have been quality assured by NZQA.  NZQA Approved number A-A-02-2015-91163-02-8143 |
| Authenticity of evidence | Assessors/educators must manage authenticity for any assessment from a public source, because learners may have access to the assessment schedule or exemplar material.  Using this assessment resource without modification may mean that learners’ work is not authentic. Assessors/ educators may need to change figures, measurements or data sources or set a different context or topic to be investigated or a different text to read or perform. |

Vocational Pathway Assessment Resource

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Learner instructions

# Introduction

This assessment activity requires you to demonstrate your understanding of the chemistry used in the development of epoxy resins used in the construction and infrastructure industries.

You are going to be assessed on how comprehensively you demonstrate understanding of the chemistry used in the development of epoxy resins used in the construction and infrastructure industries.

The following instructions provide you with a way to structure your work so you can demonstrate what you have learnt and achieve success in this standard.

Assessor/educator note: It is expected that the assessor/educator will read the learner instructions, and modify them if necessary to suit their learners.

# Task

The materials we use today are the result of historical developments, planned research, accident, and economic demand. The chemistry of new materials gives them certain properties. The properties of these materials make them useful to society.

Explain links between the chemistry and the development of epoxy resins using chemistry vocabulary, symbols and conventions, and evaluate how the chemistry influenced the development of epoxy resins.

You must carry out your work individually. Both your report and your notes will be assessed.

## Process, interpret and report

Process and interpret information provided by your assessor/educator.

Research the chemistry involved in the development of epoxy resins. Find out what experimentation, events and/or discoveries led to the development of epoxy resins.

Prepare your report using your notes only. Show clearly your understanding of the chemistry in the development of epoxy resins. Hand in your notes with your report.

In your report include:

* historical development of the technology
* appropriate chemistry vocabulary, symbols and conventions (names, formulae and equations, where appropriate)
* description of the chemistry used in the development of epoxy resins
* an explanation of the links between the chemistry and the development of epoxy resins, and how epoxy resins are useful to engineers in construction and infrastructure industries
* an evaluation on how the chemistry influenced the development of epoxy resins. This may involve elaborating, applying, justifying, relating, comparing and contrasting, and analysing information
* evidence for your conclusions, for example images of related uses, historical milestones, quotes from your research.

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Assessor/Educator guidelines

# Introduction

The following guidelines are supplied to enable assessors/educators to carry out valid and consistent assessment using this internal assessment resource.

As with all assessment resources, education providers will need to follow their own quality control processes. Assessors/educators must manage authenticity for any assessment from a public source, because learners may have access to the assessment schedule or exemplar material. Using this assessment resource without modification may mean that learners' work is not authentic. The assessor/educator may need to change figures, measurements or data sources or set a different context or topic. Assessors/educators need to consider the local context in which learning is taking place and its relevance for learners.

Assessors/educators need to be very familiar with the outcome being assessed by the achievement standard. The achievement criteria and the explanatory notes contain information, definitions, and requirements that are crucial when interpreting the standard and assessing learners against it.

# Context/setting

This activity requires learners to demonstrate their comprehensive understanding of the chemistry involved in the development of epoxy resins, including the history of their development. They will also include an account of the history of their development.

Decide on the format of the final presentation. It could be a poster, a computer presentation, a wiki, or any other suitable format.

# Conditions

This is an individual activity. You will determine the timeframe needed.

Learners may also use their own research findings. Information provided must be sufficient to meet the requirements of the standard. Research is not the intent of this standard.

# Resource requirements

None.

# Additional information

The following websites may be useful:

<http://www.glueguru.co.nz/product/12>

[www.crc.co.nz](http://www.crc.co.nz)

<http://www.adhesivetechnologies.co.nz/adrseries.html>

<http://www.acemarine.co.nz/epoxy-resins.html>

<http://resources.alibaba.com/topic/800050983/BriefHistoryofepoxyresin.htm>

# Assessment schedule: Chemistry 91163 – Sticky stuff

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| Evidence/Judgements for Achievement | Evidence/Judgements for Achievement with Merit | Evidence/Judgements for Achievement with Excellence |
| The learner demonstrates understanding of the chemistry used in the development of epoxy resins by:   * describing the development of epoxy resins * giving an overview of historical developments of epoxy resins * using chemistry vocabulary to describe the development and composition of epoxy resins   For example:  *The first commercial attempts to prepare resins from epichlorohydrin were made in 1927 in the United States. Credit for the first synthesis of bisphenol-A (C15H16O2) based epoxy resins is shared by Dr Pierre Castan of Switzerland and Dr S.O. Greenlee of the United States in 1936.*  *A wide range of epoxy resins are produced industrially. The raw materials for epoxy resin production are today largely petroleum derived; although some plant derived sources are now becoming commercially available (e.g. plant derived glycerol (C3H8O3) used to make epichlorohydrin).*  *Epoxy is both the basic component and the cured end product of epoxy resins, as well as a colloquial name for the epoxide functional group.*  *Epoxy resins are low molecular weight, pre-polymers or higher molecular weight polymers which normally contain at least two epoxide groups. The epoxide group is also sometimes referred to as a glycidyl or oxirane group.*  *Curing of epoxy resins is an exothermic reaction.*  *Amines form an important class of epoxy hardeners.*  *The applications for epoxy-based materials are extensive and include coatings, adhesives and composite materials such as those using carbon fibre and fibreglass reinforcements (although polyester, vinyl ester, and other thermosetting resins are also used for glass-reinforced plastic).*  *ACE 321 Epoxy resin is a new generation 'state of the art' epoxy polymer system, suitable for all structural bonding, filling, sheathing, fairing and timber preservation requirements.*  *The above expected learner responses are indicative only and relate to just part of what is required.* | The learner demonstrates in-depth understanding of the chemistry used in the development of epoxy resins by:   * describing the development of epoxy resins * giving an overview of historical developments of epoxy resins * using chemistry vocabulary to describe the development and composition of epoxy resins. * making and explaining links between the chemistry and the development of epoxy resins   For example:  *As early as 1891, the German Lindmann used hydroquinone (C6H6O2) and epichlorohydrin (C3H5ClO) in a condensation reaction to produce a resin and make use of anhydride curing. But its value has never been revealed. In 1930, Pierre Castan of Switzerland and Dr S.O. Greenlee of the United States do further study with organic polyamines to cure the resin, showing a very high bond strength.*  *Epoxy resins, also known as polyepoxides, are a class of reactive prepolymers and polymers which contain epoxide groups. Epoxy resins may be reacted (cross-linked) either with themselves through catalytic homopolymerisation, or with a wide range of co-reactants including polyfunctional amines, acids (and acid anhydrides), phenols, alcohols and thiols.*  *Epoxy resins are polymeric or semi-polymeric materials, and as such rarely exist as pure substances, since variable chain length results from the polymerisation reaction used to produce them. High purity grades can be produced for certain applications (e.g. using a distillation purification process).*  *As with other classes of thermoset polymer materials, blending different grades of epoxy resin, as well as the use of additives, plasticizers, or fillers is common to achieve the desired processing and/or final properties, or to reduce cost. Use of blending, additives and fillers is often referred to as formulating.*  *Curing of epoxy resins is an exothermic reaction. This may produce sufficient heat to cause thermal degradation if not controlled.*  *Primary amines form an important class of epoxy hardeners. Primary amines undergo an addition reaction with the epoxide group to form a hydroxyl group and a secondary amine.*  *[http://upload.wikimedia.org/wikipedia/commons/thumb/f/fe/Triethylene_tetramine.png/150px-Triethylene_tetramine.png](http://en.wikipedia.org/wiki/File:Triethylene_tetramine.png)*  *Structure of TETA, a typical hardener.*  *The amine (NH2) groups react with the epoxide groups of the resin during polymerisation.*  *The chemistry of epoxies and the range of commercially available variations allow cure polymers to be produced with a very broad range of properties. Epoxies are generally known for their excellent adhesion, chemical and heat resistance, good-to-excellent mechanical properties and very good electrical insulating properties.*  *The above expected learner responses are indicative only and relate to just part of what is required*. | The learner demonstrates comprehensive understanding of the chemistry used in the development of epoxy resins by:   * describing the development of epoxy resins * giving an overview of historical developments of epoxy resins * using chemistry vocabulary to describe the development and composition of epoxy resins. * making and explaining links between the chemistry and the development of epoxy resins * evaluating how the chemistry influenced the development of epoxy resins with respect to their uses.   For example:  *Epoxy resins may be reacted (cross-linked) either with themselves through catalytic homopolymerisation, or with a wide range of co-reactants, including polyfunctional amines, acids (and acid anhydrides), phenols, alcohols and thiols. These co-reactants are often referred to as hardeners or curatives, and the cross-linking reaction is commonly referred to as curing. Reaction of polyepoxides with themselves or with polyfunctional hardeners forms a thermosetting polymer, often with high mechanical properties, temperature and chemical resistance. Epoxy has a wide range of applications, including metal coatings, electronics/electrical components, high tension electrical insulators, fibre-reinforced plastic materials and structural adhesives.*  *High purity grades can be produced for certain applications (e.g. using a distillation purification process). One downside of high purity liquid grades is their tendency to form crystalline solids due to their highly regular structure, which requires melting to enable processing.*  *While it is common to associate polyester resins and epoxy resins, their properties are sufficiently different that they are properly treated as distinct materials. Polyester resins are typically low strength unless used with a reinforcing material like glass fibre, they are relatively brittle unless reinforced, and have low adhesion. Epoxies, by contrast, are inherently strong, somewhat flexible and have excellent adhesion. However, polyester resins are much cheaper.*  *The above expected learner responses are indicative only and relate to just part of what is required.* |

Final grades will be decided using professional judgement based on an examination of the evidence provided against the criteria in the Achievement Standard. Judgements should be holistic, rather than based on a checklist approach.