

Title	Demonstrate knowledge of reaction rates and mechanisms in composite manufacture		
Level	5	Credits	5

Purpose	People credited with this unit standard are able to: demonstrate knowledge of reaction rate and terms, reaction mechanism and rate law, and the effect of temperature on reaction rate; explain the catalyst or hardener and its relevance to composite manufacture; and perform calculations and draw conclusions from rate measurements and rate laws that applies to composite manufacture.
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Classification	Composites > Production Composites
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Available grade	Achieved
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Guidance Information

- All work practices must meet recognised codes of practice and documented worksite health and safety procedures (where these exceed code) for personal, product, and worksite health and safety, and must meet the obligations required under the Health and Safety at Work Act 2015, Resource Management Act 1991, Hazardous Substances and New Organisms Act 1996, and any subsequent amendments.
- Definitions

Hardeners refers to the epoxy curing agent; the curing agent is responsible for reacting with the epoxy groups contained in the epoxy resin A side. Reaction of curing agents with epoxy resins results in hard, thermoset materials.

Pseudo first order reaction refers to second order with one reactant in large excess.

Workplace policies and procedures refers to the documented procedures and policies providing guidelines of the tasks and activities carried out in the workplace. This typically includes relevant health and safety policies to manage risk in the workplace.

Outcomes and performance criteria

Outcome 1

Demonstrate knowledge of reaction rate and terms as they apply to composite manufacture.

Performance criteria

- 1.1 Reaction rate is determined in relation to the hardeners or catalyst used for composite manufacture.

- 1.2 Terms are defined in relation to the reaction rate as relevant to the materials used for composite manufacture.
- Range terms include – rate law, rate equation, rate constant, integrated rate law, initial rate.
- 1.3 Reaction rate is illustrated in terms of ‘order of reaction’ and the order with respect to materials for a given rate law relevant to materials or processes used for composite manufacture.

Outcome 2

Demonstrate knowledge of the reaction mechanism and rate law as it applies to composite manufacture.

Performance criteria

- 2.1 Elementary reactions are defined, and their rate laws are illustrated in relation to reaction mechanism in composite manufacture.
- Range unimolecular, bimolecular, trimolecular.
- 2.2 Complex reactions are illustrated as a series of elementary reactions in relation to reaction mechanism that applies to composite manufacture.
- 2.3 Rate law is illustrated for a two-step reaction in relation to reaction mechanism that applies to composite manufacture.
- Range step 1 rate-determining, step 1 fast equilibrium – step 2 rate-determining.

Outcome 3

Perform calculations and draw conclusions from rate measurements and rate laws that apply to composite manufacture.

Performance criteria

- 3.1 Rate law is determined in terms of effect of initial concentrations on initial rates required for composite manufacture.
- 3.2 Rate law is deduced in terms of concentration time plots that applies to composite manufacture.
- Range first order, second order with equal initial concentration of reactants.
- 3.3 Rate constant and half-life are determined from concentration time plots for a first order reaction or pseudo first order reaction that applies to composite manufacture.

- 3.4 Rate constant is calculated from a plot of inverse of concentration of a reactant or product against time for a second order reaction that applies in composite manufacture.

Outcome 4

Demonstrate knowledge of the effect of temperature on reaction rate for a composite product.

Performance criteria

- 4.1 Energy of activation is described in relation to reaction rate that applies in composite manufacture.
- 4.2 The variation of reaction rate with temperature, and the energy of activation is determined as it applies in composite manufacture.

Range may include – an Arrhenius plot.

Outcome 5

Explain the catalyst or hardener and its relevance to composite manufacture.

Performance criteria

- 5.1 The effect of a catalyst or hardener is explained in terms of the reaction as it applies to use in composite manufacture.

Range effects include – rate of reaction, position of equilibrium.

- 5.2 The role of a catalyst or hardener is explained in terms of reaction mechanism as it applies to composite manufacture.

Planned review date	31 December 2027
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Status information and last date for assessment for superseded versions

Process	Version	Date	Last Date for Assessment
Registration	1	25 August 2022	N/A

Consent and Moderation Requirements (CMR) reference	0136
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This CMR can be accessed at <http://www.nzqa.govt.nz/framework/search/index.do>.

Comments on this unit standard

Please contact Hanga-Aro-Rau Manufacturing, Engineering and Logistics Workforce Development Council qualifications@hangaarorau.nz if you wish to suggest changes to the content of this unit standard.