General Approval application example:
Paint Formulation

RESEARCH + DEVELOPMENT TAX INCENTIVE

IMPORTANT NOTE

This is a fictitious example of a General Approval application. It is intended as a guide only to provide an indication of the level and type of detail required in the RDTI General Approval form.

For information about R&D activities that are eligible for the RDTI, and the RDTI application process, refer to the **RDTI Hub** and the *Research and Development Tax Incentive: Guidance* **IR1240**.

1. PROJECT DESCRIPTION

1.1. Project Identifier

High performance, VOC-free water based paint, incorporating a novel Reactive Coalescing Agent (RCA).

1.2. Project Objective

The aim of this project is to develop a water-based latex paint with improved performance, as well as being more ecologically friendly.

We propose to achieve this by using a novel Reactive Coalescing Agent (RCA) in the paint.

Coalescing agents play an important role in paint, softening the polymer (the binding agent that holds the coloured pigment together) to enable the paint to be evenly applied so that it dries as a solid, uniform, continuous film.

Traditionally, two groups of organic compounds have been used as coalescing agents in water-based paint:

- those with a boiling point < 250 degrees C, also known as a Volatile Organic Compound, or VOC
- those with a boiling point > 250 degrees C, also known as a Semi-Volatile Organic Compound, or sVOC.

While both groups are effective at performing their ‘polymer softening’, they evaporate into the atmosphere on application, where they can harm both human health and the environment.

The most commonly used coalescents in water-based latex paints have been sVOC solvents. These are less easily absorbed into the atmosphere than their VOC counterparts. However, they also produce a less robust paint film.

The novel RCA we aim to develop will address both the environmental and durability shortcomings associated with these traditional coalescing agents.

This is because the novel RCA will chemically bond to the polymer during film formation and coalescence, rendering it non-volatile, i.e. it won't evaporate into the atmosphere, avoiding the potentially harmful side- effects associated with traditionally used solvents.

In addition, we anticipate that the new RCA will result in a longer-lasting coating. This is because it will be tailored specifically to the polymer structure, enabling a higher concentration of coalescing agent in the paint and also allowing for a harder, more durable polymer to be used.

2. PROJECT'S CORE R&D ACTIVITIES

2.1. Core R&D Activity

To optimise the structure of a novel RCA.

2.1.1. Describe your Core R&D Activity

This core activity involves developing a novel RCA that will react with the available chemical functionality on our proprietary polymer backbone.

Once chemically bonded to the polymer, the RCA will:

- essentially become non-volatile, and therefore unable to leach from the film
- be rendered inactive as a coalescing solvent, allowing the final film to reach its desired hardness.

The requirements for the new RCA are:

- In its free form, it must have a boiling point of > 250 °C at 101.3 kPa in order to be considered an sVOC.
- The solubility characteristics of the RCA must be compatible with our proprietary polymer to be an efficient coalescent during film formation in its unbound state. The key performance parameter of the developed RCA is reducing the minimum film forming temperature of the proprietary polymer latex to between -5 °C and -10 °C at a total formulation loading of < 7.5 wt.%.
- Once reacted and bound to the polymer, the RCA must not increase the water sensitivity of the polymer or reduce its glass transition by more than 5 °C.

2.1.2. Describe the Scientific or Technological Uncertainty that your Core Activity has a Material Purpose of Resolving

The current technological uncertainty or knowledge gap concerns the generation and application of the RCA. It is scientifically uncertain whether a polymer-specific RCA can be prepared that will meet all the performance requirements necessary for this project.

The use and generation of RCAs have been covered in the publicly available literature and to the best of our knowledge, this technology has already been used in commercial products. However, in this instance, the literature does not apply due to the choice of reactive groups and unique characteristics of our proprietary polymer. Additionally, the commercial knowledge is held as a trade secret and is not available to us.

In the absence of any relevant literature, our team of experienced product developers (including a specialised chemist who has worked successfully with RCA technology in other contexts) was unable to deduce that our proposed application of a novel RCA would be successful, without conducting the systematic approach detailed below.

2.1.3. Describe the Systematic Approach you took to Conducting the Core Activity

A series of small molecules will be designed with the chain length, substituent groups and branching, being varied by the required reactive functional group. (Details of the specific functional group would be expected to be provided.)
A Design of Experiments (DoE) approach will be used to investigate solvency/compatibility, reactivity and the effect on the minimum film forming temperature proprietary polymer latex.
The boiling point of all RCA samples will also be determined as well as the glass transition temperature of the final polymer film to ensure the RCA specifications are met.

Key points in the experimental plan (anticipated completion dates should be provided for each):

- Define required reactive functional group and RCA properties.
- Synthesis RCA compounds (varying length, branching and constituents).
- Characterise novel RCA compounds.
- Determine RCAs solvating and volatility profile.
- Determine the minimum film forming temperature and changes in glass transition with respect to RCA loading
- Investigate RCA polymer rate of reaction and extent of incorporation Refine RCA design
- Repeat testing step
- Identify lead compounds to take forward to small scale paint trials

2.1.4. Describe how your Core Activity intends to create either New Knowledge or New or Improved Processes, Services or Goods

This core activity intends to create new knowledge with respect to the development of polymer specific RCAs and contribute to the development of a new high performance VOC-free water-based coating.

2.1. Core R&D Activity

Coating formulation performance using the novel RCA.

2.1.1. Describe your Core R&D Activity

The core activity is to determine the effect of the novel RCA compound on the formulated paint product's critical attributes; long term performance, and the in-can stability of the paint.

2.1.1. Describe the Scientific or Technological Uncertainty that your Core Activity has a Material Purpose of Resolving

Paint is a multi component system, where small changes in the constituents can cause dramatic effects on the performance and stability of the final product.

The paint and the final coating must meet a set of internal performance and stability requirements, and it is uncertain how the new RCA will behave in the paint formulation and what the impact will be on the required properties within the formulation range.

As the RCA is a novel material developed specifically for this application, there is no prior knowledge of how the newly developed RCA will perform when formulated as part of a water-based coating or its interactions with other components.

Our team of product developers was therefore unanimous that the novel RCA's contribution to the formulated paint's critical attributes could only be established by conducting the systematic approach detailed below.

2.1.2. Describe the Systematic Approach you took to Conducting the Core Activity

A series of experiments will be performed to systematically investigate all key performance characteristics of the formulated paint and final film coating. All key parameters are determined by a set of internal or international standards and the data from each experimental set will be recorded and evaluated against a set of internal performance criteria.

Key points in the experimental plan (anticipated completion dates should be provided for each):

- Testable quantities of each of the lead RCAs will be synthesised and characterised. A minimum purity of 95% is required for testing.
- Small scale paint batches will be prepared using each of the lead RCA compounds at staggered dosing rates. The test formulation will be based on a current commercial formulation using our proprietary latex and substituting the commercial available coalescing solvent package with an RCA.
- Each formulation will undergo the following testing:
  - Dry film durability testing
  - Application and film performance testing
  - Colourant acceptance
  - In can stability (accelerated and long term)
  - Long term and accelerated weathering
  - VOC off gassing during drying
- All test results will be analysed and an internal test report, capturing results and new knowledge, will be generated.

In addition to the previous work, this experimental program will also help inform the correct dosing rate of the new RCA within the required minimum film forming temperature parameters.

2.1.3. Describe how your Core Activity intends to create either New Knowledge or New or Improved Processes, Services or Goods

This core activity develops new knowledge regarding the effect of the novel RCA on the formulated latex paint's performance and stability characteristics. In addition, this work will help to inform the ongoing development of a new high performance VOC-free water-based architectural coating.

3. PROJECT'S SUPPORTING ACTIVITIES

3.1. Supporting Activity (1)

Literature survey and freedom to operate search.

3.1.1. Describe your Supporting Activity

A comprehensive literature review and freedom to operate search was completed to determine the current 'state of the art' in coalescents and RCA technology, with regards to latex based paints and film formation.
This work was completed during the project initiation and planning phase to help define and direct the course this project aims to complete.

3.1.2. Describe how this satisfies the Supporting Activity definition

This activity supports the core one below by giving the project team a thorough understanding of the current technology landscape and what the limitations are on the current technology.

3.1.3. Related Core R&D activity

To optimise the structure of a novel RCA.

3.2. Supporting activity (2)

Project management, project documentation, milestone meetings, project communication.

3.2.1. Describe your Supporting Activity

This supporting activity covers all aspects of project planning to ensure that key milestones are met, and progress is continuously tracked and monitored.
With regards to the wider project team, regular project meetings will be scheduled, where key decisions will be noted and action items circulated.
All data generated will be recorded and reviewed to enable completion of the core activity and resolution of the technical uncertainty.

3.2.2. Describe how this satisfies the Supporting Activity definition

Undertaking this supporting activity was required to provide the necessary means to document, track and steer both core activities described in this application.
Without this supporting activity, it would not be possible to capture the new knowledge or determine when the uncertainty had been resolved, marking the end of the core activity.

3.2.3. Related Core R&D activity

To optimise the structure of a novel RCA.
Coating formulation performance using the novel RCA.

3.3. Supporting activity (3)

50L test batch production.

3.3.1. Describe your Supporting Activity

R&D specific test batches (50L) were produced using our small scale production line. These batches were used for R&D testing purposes only, relating to understanding the coating's performance properties in relation to the addition of the novel RCA.

The batches were specifically formulated to use the RCA, and all test batch production documentation was maintained in accordance with our internal procedures.

This activity also included the disposal of any test batch material that was not used during testing, once the core activity was completed

3.3.2. Describe how this satisfies the Supporting Activity definition

The production of small scale test batches is essential to the investigation described in the core activity "Coating formulation performance using the novel RCA".

These small scale test batches are required to determine the coatings properties and the impact of the RCA on the formulation.

3.3.1. Related Core R&D activity

Coating formulation performance using the novel RCA.