Blue Pacific MINERALS

CLEVER by NATURE

ECO-ADVANCING RUMINANT HEALTH: OPTIMATE™ PARTNERSHIP DOSSIER FOR METHANE REDUCTION INNOVATORS

Agriculture

Plant+Soil+Turf

Home+Health

Environmental

Industrial

1.

EXECUTIVE SUMMARY

This dossier is curated to guide and inform potential partners about the potential role of **Optimate**™ in addressing the global challenge of methane emissions from ruminants - a key factor in climate change.

Optimate™, our registered trademark for our proprietary Zeolite formulation. This ACVM registered product (A011800), is a versatile and effective carrier that not only promises enhanced animal health through its mycotoxin binding and rumen buffering capabilities but also stands as a potential ingredient in methane mitigation strategies.

Optimate™ harnesses the natural aluminosilicate properties of BPMNZ's 100% Natural BPMNZ Zeolite in powder or dispersible granule form to deliver a multi-functional product. It acts as a mycotoxin binder, improving animal welfare and production across various lactation stages and feed systems. As a rumen buffer, it maintains a healthy pH, even in diets high in grains or during periods of lush pasture growth, ensuring optimal rumen health. Moreover, **Optimate**™ has been proven to reduce rumen ammonium production, enhancing nitrogen utilisation and supporting cows in negative energy balance.

With its unique formulation, **Optimate**™ serves as a carrier that enriches animal feeds with high-value additives without loss during mixing, and can be 'loaded' with liquids, upholding a dry state which facilitates handling and integration into feed systems.

Applications extend beyond its inherent benefits to a transformative role in methane reduction, offering a substantial commercial opportunity to partners focused on environmental sustainability and regulatory compliance in the agricultural sector.

This document outlines scientific backing, regulatory compliance, quality assurance, and the commercial and partnership opportunities **Optimate**™ presents. It underscores **BPM's** commitment to innovation, collaboration, and comprehensive support for partners through its technical expertise, route-to-market strategies, and a strong stance on intellectual property and confidentiality.

Optimate™ is positioned as an important element in solutions for methane reduction and is ready to be harnessed by innovators looking to make a significant impact on ruminant health and the environment. This dossier provides the foundational knowledge, scientific validation, and commercial insights necessary for developing and implementing methane reduction solutions with **Optimate**™ as a central component.

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INTRODUCTION TO METHANE EMISSIONS IN RUMINANTS

REDUCING METHANE EMISSIONS

Reducing methane emissions from cow digestive systems is a critical concern for both environmental sustainability and climate change mitigation. Researchers have been exploring various methods to reduce methane emissions from cows, including the use of different probiotics, feed additives, and dietary changes.

Some approaches that have been studied include:

1. **Direct-fed Microbials (DFMs):** Also known as probiotics, these are beneficial microorganisms that are added to the animal's diet. Some strains have been shown to reduce methane production by altering the microbial community in the rumen, although the results can be variable.
2. **Seaweeds:** Some studies have shown that certain types of seaweed can dramatically reduce methane emissions when added to the cow's diet in small amounts.
3. **Genetic Selection:** Breeding animals that naturally produce less methane is a longer-term strategy that is currently being researched. LIC are working on this
4. **Vaccines:** There is ongoing research into developing vaccines that could inhibit the microbes responsible for methane production, although this is still in the experimental phase.

CLIMATE CHANGE POLICY & REGULATORY LANDSCAPE

New Zealand has been actively working on addressing climate change, including the greenhouse gas emissions from its agriculture sector, which is a significant part of its economy. Livestock farming, particularly dairy and sheep farming, is a major source of methane emissions in the country.

Here are some of the strategies and policies New Zealand has been exploring or implementing to reduce GHG emissions from livestock:

Regulatory Framework:

- **Zero Carbon Act:** Passed in 2019, the Climate Change Response (Zero Carbon) Amendment Act aims to make New Zealand carbon-neutral by 2050. It sets specific targets for methane reduction from livestock: a 10% reduction by 2030 and a provisional reduction ranging between 24% and 47% by 2050 compared to 2017 levels.
- **Emissions Trading Scheme (ETS):** New Zealand has an Emissions Trading Scheme that places a price on greenhouse gas emissions. The agriculture sector has been partially exempt, but there have been discussions to include it more fully in the future.
- **He Waka Eke Noa:** This is a partnership between the agri-food sector and the government aiming to reduce and manage farm emissions. The plan, as of 2021, was to implement a pricing mechanism for agricultural emissions by 2025 if farmers do not voluntarily reduce emissions effectively.

Research and Development:

Low-Methane Breeding: Research has been conducted on breeding sheep and cattle that produce less methane.

Methane Inhibitors: Research is also being carried out on feed additives that can reduce methane emissions during digestion.

Manure Management: Technologies such as anaerobic digestion are being explored to capture methane from manure for use as bioenergy.

Incentives and Support:

Financial Support: The government has invested in research and development to find effective ways to reduce livestock emissions.

Extension Services: There are advisory services to help farmers adopt more sustainable practices, including those that reduce emissions.

Public Awareness: The government and industry groups are working on raising awareness about the environmental impacts of livestock farming and the need for sustainable practices.

Challenges:

Economic Impact: The livestock industry is crucial for the New Zealand economy, making it a sensitive topic when it comes to imposing strict regulations.

Technology Availability: While research is ongoing, readily available and cost-effective solutions for farmers are limited.

Measurement and Monitoring: Accurate measurement of emissions at the farm level is technically challenging, making it difficult to assess the effectiveness of reduction efforts.

3.

OVERVIEW OF OPTIMATE™

Optimate™

Key focus areas for Optimate™ use

Optimate™ is an ACVM registered animal health product.	
TRADE NAME	Optimate™
ACVM REGISTRATION NUMBNER	A011800
ACTIVE INGREDIENTS & CONCENTRATIONS	100% Natural BPMNZ Aluminosilicate
FORMULATION TYPE	Powder
GENERAL USE CLAIM	Mycotoxin Binder

MYCOTOXIN BINDING

Optimate™ as a Mycotoxin Binder: There are several papers in the scientific literature supporting zeolite's effect as a mycotoxin binder. **BPM's** own in vitro research supports this. Mycotoxins produced by moulds decrease animal health and welfare, fertility and production at ANY stage of the lactation. They can come from grazing pasture, eating mouldy silage (maize and grass), improperly stored PKE and cereal grains.

Application areas are:

- In early lactation, when cows are immune suppressed and esp. with adverse weather condition, cows are more susceptible to mycotoxins *(System 1 to 5).*
- When supplements are fed *(poor storage of PKE silage; System 2, 3 & 4 predominantly).*
- Any time when imported grains are fed *(System 5)*
- In autumn, with FE risk *(the lower the pasture residual the higher the FE risk; System 1 to 3).*
- Any time when there is prolonged period of dry and humid weather *(Esp. Systems 1, 2 & 3).*

RUMEN HEALTH

Optimate™ as a rumen buffer: There are several papers in the scientific literature supporting zeolite's buffering capacity. **BPM's** own research also supports this, as in the MetStall trial the rumen pH profile was continuously higher than that in the control cows, even though all cows had a healthy rumen pH to start out with. Had the pH been lower, the buffering effect would have been likely statistically significant

Application areas are:

- With high grain feeding *(System 4 & 5)*
- With high PKE feeding, esp. during drought *(System 2, 3 & 4)*
- During spring with lush pasture, possibly all Systems, but esp. if PKE and/or grain supplements are fed.
- With turnip and fodder beet feeding - mostly in late lactation.

DECREASE RUMEN AMMONIUM PRODUCTION

Optimate™ lowering ammonium production: There are several papers in the scientific literature supporting zeolite's effect on lowering rumen ammonium production. **BPM's** own research supports this. If there is too much protein in the diet or not enough energy, the microbes cannot convert all dietary protein/N into microbial protein and "waste" any excess into ammonium. Ammonium is absorbed into the blood and is highly toxic to the cow. Therefore, the liver converts it into urea - there is quite an energy cost of this detoxification, energy that could be used for milk production.

Application areas are:

- In spring when there are very high levels of protein in the diet and lots of excess ammonium in rumen *(Systems 1, 2 & 3; higher systems likely feed higher proportion of starch supplements and/or maize, so better N utilization in rumen).*
- During early lactation, when cows are in negative energy balance (NEB) *(System 3, 4 & 5)* - the higher the milk yield, the greater the NEB
- Any situation where SARA may be a problem *(System 2 - 5)*
- Regulatory status and ACVM (Agricultural Compounds and Veterinary Medicines) registration details.
- Mechanism of action as a carrier.

4.

PRODUCT SPECIFICATIONS

DETAILED COMPOSITION & PROPERTIES	
DESCRIPTION	**BPM** Zeolite Products are produced from quality Hydrated Ca-Na-K Aluminosilicates / mordenite
TYPICAL APPLICATION	Use: As a feed and toxin binder, animal feed
	additive: 1.25-5% inclusion rate,
	chemical/probiotic carrier
TYPICAL CHEMICAL ANALYSIS - XRF - %	SiO2 71 Na2O 2.0
	Al2O3 13 K2O 4.0
	Fe2O3 1.2 TiO 0.2
	MgO 0.6 LOI 6.5
	CaO 1.5
TYPICAL PHYSICAL PROPERTIES	Bulk density 0.48 - 0.65gm/cm3
	Porosity 60%
	Slurry pH 8.65 (10% aq. suspension)
	CEC 100-120meq/100gm
	Moisture Content 8-12%
	Surface area >200m2/gm
	Pore size 7 Angstroms
	Colour Off White
STABILITY & SHELF LIFE	36 Months
HANDLING & STORAGE REQUIREMENTS	Keep under cover and in Dry Conditions

5.

EFFICACY OF **OPTIMATE™** AS A CARRIER

On top of **Optimates™** product functionality it is also used as a carrier by a number of leading animal health companies.

Optimate™ has several functional modes when used as a carrier

1. **Optimate™** can be mixed with a range of additives like minerals as an example and a binder into a dispersible granule. The granule allows high value additives to be bound into a deliverable package and added to animal feed without 'falling though' the mix
2. **Optimate™** can be 'loaded' with liquids including a range of biologicals and inoculants. This resultant product remains dry even after loading up to 35% w/v

Production Process & Supply Chain:
BPM have a number of production processes for creating dispersible granules and loading liquids to **Optimate™**. This includes temperature controlled materials handling.
BPM carries a wide range of minerals and additives which can help with supply chain optimisation as the entire process can be kept in house

*Furthermore, **BPM** has a Bioreactor for making microbial ferments to customer prescriptions.*

6.

SAFETY PROFILE

*See **Optimate**™ Safety Data Sheet*

7.

REGULATORY COMPLIANCE & QUALITY ASSURANCE

Compliance with ACVM standards registration number A011800

Blue Pacific Minerals has a GMP registration number NZ/GMP/083/A/1/2022

PARAMETER	RANGE *Include units if appropriate*	METHOD
MOISTURE	<15%	Oven drying, in-house method
SIZE	<1.2mm	Sieve test, in-house method
COLOUR	Off white	Visual inspection, in-house method
HEAVY METALS - ARSENIC *Composite quarterly sample*	<30 mg/kg	External lab, NU030 - Eurofins
HEAVY METALS - CADMIUM *Composite quarterly sample*	<10 mg/kg	External lab, NU053 - Eurofins
HEAVY METALS - MERCURY *Composite quarterly sample*	<0.1 mg/kg	External lab, NU212 - Eurofins
HEAVY METALS - LEAD *Composite quarterly sample*	<60 mg/kg	External lab, NU178 - Eurofins
COLIFORMS (YR 0 AND 3)	<1000 cfu/g	External lab, AOAC 991.14 - Eurofins
SUM OF DIOXINS & DIOXIN LIKE PCBS	<1.5ng/kg	External Lab, using the WHO-TEFs (toxic equivalency factors), 2005 - Eurofins
MORDENITE CONTENT *Composite quarterly sample*	>60%	Panda Geoscience - XRD (X Ray Diffraction) Scan and Qualitative Mineral Identification
MORDENITE CONTENT *Composite quarterly sample*	>60%	Mineralogical Interpretation & Quantification GNS Science - Wairakei. Can also do XRD

8.

CASE STUDY: **OPTIMATE™**, KEMIN & DIAMOND V

One of the most successful integrations with **Optimate™** is the combination of Kemin Clostat probiotic and Diamond V yeast. When combined with **Optimate™** solution, it emerges as a revolutionary product that redefines the landscape of livestock nutrition.

Designed to elevate rumen performance, buffering capacity, and overall animal health, **Optimate™** leverages the synergies between Clostat probiotic and Diamond V yeast to create a leading-edge formulation.

At the core of this **Optimate™** integration is the Kemin Clostat probiotic, which excels in fostering a balanced microbial environment within the digestive system. This seamlessly combines with the unique attributes of Diamond V yeast, renowned for its capacity to enhance rumen fermentation and optimize nutrient utilization. The result is a product that not only supports a thriving community of beneficial microorganisms in the rumen but also facilitates efficient digestion and absorption of nutrients.

Optimate™ market leadership is marked by its comprehensive approach, addressing the intricate needs of ruminants. By promoting optimal rumen function and bolstering buffering capabilities, this integrated solution goes beyond traditional offerings. It enhances feed efficiency, maximizes nutrient utilization, and elevates overall animal performance. The emphasis on rumen health extends to robust buffering mechanisms, ensuring pH stability to prevent digestive disorders and contribute to the holistic well-being of the animals.

In essence, **Optimate™**, driven by the effective integration of Kemin Clostat probiotic and Diamond V yeast, emerges as a trailblazing product.

It not only advances rumen performance but also establishes new benchmarks in promoting optimal rumen buffering and comprehensive animal health.

__Optimate™__ offers a holistic solution to reshape the standards for supporting the well-being and productivity of ruminant animals.

9.

COMMERCIAL OPPORTUNITIES

Methane is a global problem in ruminants, a stable high value solution offer significant commercial opportunities in all key markets.

Optimate™ competitive advantage over other carriers include;

1. Ability to leverage the **Optimate™** Brand
2. A comprehensive solution by combining the **Optimate™** Product Functionality with Methane inhibitor technology for added value proposition
3. ACVM Registration to fast-track solutions to market

10.

SUPPORT & PARTNERSHIP OPPORTUNITIES

- **BPM** offers a wide range of technical support in new product development (NPD) From extensive product knowledge to unique proprietary production processes and testing.
- **BPM** has a sales team and route to market with all major rural retailers
- NPD collaboration is always under a confidentiality agreement and we can work as closely or as independently as our client desires
- **BPM** has a documented stage gated development process to drive and track progress
- **BPM** has a network of external technical/science service providers that could be leverage in any NPD project
- **BPM** are happy to enter into commercial licencing agreement to ensure a stabile and reliable supply of materials and service. **BPM** does not however offer exclusive partnerships

11.

INTELLECTUAL PROPERTY & CONFIDENTIALITY

There is a number of IP and confidentiality topics to work through in joint development opportunities.

Some relevant points to consider:

- Optimate™ is a registered trademark of **BPM**
- Through confidentiality agreements we are commitment to protecting partners' proprietary information.
- Employees have confidentiality agreements and non-disclosure agreements in place
- With any new technology it is most likely best protected with a mix of patents, trade secrets, copyright, and other measures. While a patent-all approach can work, this must be balanced against budgets - which is why less expensive alternatives to patents must also be considered.
- What constitutes patentable subject matter is broader than many people think. For example, with **BPM**, potentially patentable subject matter can include:

  1. Specific synergistic combinations in the mixes - using a selection invention approach (more details below)
  2. Ratios of the elements - particularly if matched to a specific application
  3. Release characteristic profiles
  4. Application schedule - e.g. x grams per dose123

Other Relevant IP consideration:

1. Ensure confidentiality throughout any trials
2. Ensure that you implement friendly farmer agreements that are clear around IP ownership (if they suggest something, you still own it) and confidentiality
3. Understand that you can conduct experimental trials before filing a patent application - but confidentiality is still preferred for the trials
4. Explore patentability of the product considering the following:

   4a. How you achieve the appropriate dispersibility rate

   4b. Ratios of the ingredients to each other

   4c. Application rates

5. Manufacturing process

   5a. Explore what can be kept a trade secret - for example, the manufacturing process and aspects of that

12.

OPTIMATE™ ADDITIONAL INFORMATION & REFERENCES

Animal health and nutrition: Zeolites also have a long history of being used in animal husbandry, as feed additives in monogastric and ruminant animals and can be safely fed on a daily basis [6,7,8]. In the US, it has GRAS status and in the the EU it is authorised as a feed additive for all animal species (EU no. 651/2013).

Although, to date there has been little research on its effect on methane emission from the rumen, one study showed, using an artificial rumen system, that methane production was reduced when zeolite was included into the diet [9]. In contrast, there is considerable research to show the positive impact of zeolite on dairy cow performance [10] and improving the energy balance in early lactation [10,11]. A recent metabolomics and proteomics study showed that 21 different metabolites and proteins involved in energy metabolism were differentially expressed in cows supplemented with zeolite during early lactation, possibly explaining its positive effect on energy balance [12].

Zeolite also plays an important role in helping to improve ruminal fermentation. It increases the acetate to propionate ratio, lowers ruminal excess ammonia production and helps maintain ruminal pH [10]. Our own research with **Optimate**™ in lactating cows confirmed its role in helping to lower excess ruminal ammonia production and maintaining ruminal pH [12,13].

In addition to its beneficial effects on ruminal function, zeolite is also a well-known mycotoxin inhibitor [14]. These are toxins that are produced by spoilage fungi present in fresh or stored animal feed. Ingested mycotoxins can cause significant productivity losses and animal welfare issues, and even death, in all livestock species, including in ruminants [15]. **Optimate**™ is registered in New Zealand as a mycotoxin inhibitor [16].

13.

APPENDICES

ACVM Registration Certificate

Optimate™ Material Safety Data Sheet (MSDS)

GMP Certificate

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