OXIFORTE
TECHNOLOGY INFORMATION of PRODUCT

Trade name: OXIFORTE
Formulation type: Powder
Active ingredient: Calcium Peroxide (CaO₂)

**Scope of application:**
- Calcium peroxide releases oxygen slowly in contact with atmospheric moisture and used to generate contaminated soils and lakes. It is used as a slow oxygen release source in agricultural application.
- It is used in the bleaching and deodorizing.
- Used as a curing agent in rubber, starch modification, dough conditioner, industrial oxidizer, ingredient in deodorizers, cosmetics and dentifrices and in Agriculture, metallurgy, bioremediation, aquaculture, animal rearing.

**In environmental protection:**
1. For treating waste water and remediation of groundwater.
2. For decontaminating soil.

**In aquaculture:**
1. To provide sufficient dissolved oxygen.
2. To adjust pH value.
3. To reduce the subaqueous content of ammonium and nitrogen.
4. To eliminate carbon dioxide and sulfurred hydrogen.
5. To prevent anaerobe from proliferation and killing nosogenetic bacteria, defecating aqueous body.

**In poultry-raising:**
1. To decontamination of fodder.
2. To increase productivity, hens safety and improving their eggs.

**In cattle-breeding:**
1. For prophylaxis of casein-stone formation in the abomasum and diarrhoea with newborn calves.
2. For an antimicrobial effect;
3. For stimulating protective organism strength;
4. For normalizing activity of the alimentary canal;
5. For activating digestion work;
6. For greater live-stock safety.

**In precious metal production:** for leaching precious metals in the formation of cyano complexes (particularly complexes with gold and/or silver) from ores, ore concentrates, and other particle-shaped, solid materials.

**In bakery industry:**
1. to improve bread crumb and its porosity;
2. to keep moisture in dough during its baking;
3. to initiate yeast growth.

**In dental care:** for tooth bleaching

**In agriculture**
- as fertilizing rich with oxygen;
- for stimulating seed growth and their germinating power;
- For pre-sowing treatment of rice seed, which allows to do planting not by seedlings, but by dry seeds coated with calcium peroxide. Such a technique sufficiently decreases work

  - Coating rice seeds with calcium peroxide (CaO₂) promotes seedling emergence in flooded soil.
  - Calcium peroxide coating in addition shows much less seed loss.
  - The seedlings are able to take up the dissolved oxygen (CaO₂ + H₂O →Ca(OH)₂ + 1/2 O₂).

(http://dspace.irri.org:8080/dspace/bitstream/123456789/295/2/9712200108_content.pdf)
Coating seeds with an O\textsubscript{2}-releasing chemical, calcium peroxide (trade name: Calper), makes sowing into anaerobic soil possible (Yamada 1952).

Calcium peroxide, in contact with water, produces oxygen that would be available to the germinating rice seeds in anaerobic soil. Coating with Calper creates an aerobic environment around the seed.

(http://dspace.irri.org:8080/dspace/bitstream/10269/139/1/limited%20proc%2010.pdf)

- Oxygen is essential at the roots for water and nutrient absorption during photosynthesis.
- During this stage plants are metabolizing macro and micronutrients, as well as enzymes, hormones, organic acids, etc. for storage in plant tissue to fuel growth.
- Plant friendly microbes require a constant supply of oxygen in order survive and flourish.
- Without a good supply of oxygen, anaerobic microbes may begin to set up shop, thus leading to a host of problems including nutrient deficiencies, and root disease.
- Recent studies suggest that individual plant cells under attack from viruses require tremendous amounts of oxygen to oxidize themselves (sort of a cell “suicide”) in order to prevent neighbouring cells from becoming infected with the virus.
- As all living things, plant viruses require food, which tends to be plant D.N.A. and R.N.A.
- So once the cell has destroyed itself, the isolated virus must starve and die, leaving behind healthy and uninfected plant cells.
- Calcium peroxide is also known to be useful in land farming.
- In clayey soils it can provide a source of oxygen and improve hydraulic conductivity, permitting more efficient movement of nutrients and oxygen through the soil.
- The calcium peroxide treated soils shows increased total microbial populations and species diversity.
- Increasing species diversity suggests the ability to degrade a wider range of chemical contaminants.

**Below are some applications for crop growing:**

**Potato** - by disseminating 8 kg of calcium peroxide on 10 acre land, the production may be increased by 43%.

**Melon** - in a green house fertilize the individual plant with 60 grams of calcium peroxide, the fruit bearing number can be increased by 30%, and sweetness can be enhanced by 7%.

**Strawberry** - fertilize the individual plant with 2 grams of calcium peroxide, the fruit bearing number can be increased by 30%, the individual fruit weight can be increased by 30%, and sweetness can be enhanced by 30%.

**Cotton** - fertilize the individual plant with 5 grams of calcium peroxide, the fruit bearing number can be increased by 30%, the individual fruit weight can be increased by 30%, and sweetness can be enhanced by 12%.

(http://www.runyoutech.com/htm/faq.htm#12.%20What%20is%20calcium%20peroxide?)

- The effects of three water table (WT) depths (0, 15 and 40 cm) and calcium peroxide (Calper) on the growth and yield of cowpea (*Vigna unguiculata*, L.) and soybean (*Glycine max*) were investigated in field lysimeters for a sandy loam soil.
- Cowpea growth was the best at 40 cm WT depth.
- Leaf area, plant height, dry matter production, number of leaves and pods, grain yield and consumptive water use of cowpea increases with deeper (lower) WT depth.
- Application of calcium peroxide improved per cent emergence, leaf area, dry matter, number of leaves and pods, weight of 100 seeds, grain yield and water use in cowpea.
- The optimum WT depth for vegetative growth of soybean was 15 cm, although the highest grain yield was obtained at 40 cm WT depth.
- Number of pods, grain yield and water use efficiency of soybean increased with deeper water table depth.

Application of calcium peroxide to soybean increased number of leaves and pods per plant, and grain yield for the 15 cm WT depth treatment. (L. T. Ogunremi, R. Lal and O. Babalola; Effects of water table depth and calcium peroxide application on cowpea (*Vigna unguiculata*) and soybean (*Glycine max*); *Plant and Soil*; Volume 63, Number 2 / June, 1981)
Use of calcium peroxide significantly increased crop emergence, plant population and their dry matter production; reduced the weed growth significantly.

It also recorded significantly higher number of panicles and grains/panicle.

Grain and straw yields were increased owing to use of CaO2 by 60 and 22 per cent, respectively in comparison to pre-germinated seeds alone.

This was due to the fact that CaO2 supplies oxygen for seed respiration and thereby increases germinability. Besides the oxygen supply makes seedling emergence and establishment stable and brings about sufficient vegetative growth, and ultimately higher yield is the outcome.

Also it may have certain effect on raising the soil pH up and thus on increasing nutrient availability.

Similar results were reported by Sen and Gulati (1983) and Nair et al. (1986).

(H. KALITA and A. K. GOGOI; Effect of Variety Calcium 'Peroxide and Weed Control on, the Performance of Direct Seeded Late Kharif Rice; Indian J. Weed Sci. 24 (1&2): 100..103 1992).

Effect of ORC (oxygen release compound) on organogenesis in PLB (protocorm-like body) cultures of Cymbidium finlaysonianum was examined.

Proliferation of PLB was promoted by addition of ORC at concentrations over 30 mg/l.

Addition of ORC to culture medium resulted in a significant increase in shoot numbers developed from PLBs.

Number of shoots were increased 1.8 fold compared to that after control treatment.

Glasshouse trials indicate the optimum coating for rice seed as 35% (w/w) on seed weight of 60% calcium peroxide.

Coatings in excess of this show no improvement and a 20% (w/w) coating gives comparable results to pre germinated seed.

As compared with untreated or pre germinated seeds an optimum seed coating of calcium peroxide increases the number of seedlings emerging through the water layer when rice seed is sown on the soil surface of waterlogged soil or at a depth of 1 cm below the soil surface.

The coating is applicable to a wide range of rice growing temperatures and not influenced by soil type.

(Ann M. Baker and William Hatton; Calcium peroxide as a seed coating material for paddy rice; Plant and Soil; Volume 99, Numbers 2-3 / June, 1987)

‘CaO2’ increased overall carbon release from axenic wheat seed, especially at 17 and 21 % v/v) O2 concentrations, but fructose and glucose exudations were inhibited.

Total carbohydrate released was not affected. Sucrose exudation was detected from ‘CaO2 treated seed, but not from untreated seed.

The major form of carbon released from seeds was not carbohydrate and possibly originated from the seed coat.

Although exudates supported substantial fungal and bacterial growth, the antimicrobial properties of the formulation suggest that it has potential as a plant protection chemical.

(M. SLADDIN AND J . M. LYNCH; Antimicrobial Properties of Calcium Peroxide in Relation to Its Potential Use as a Seed Dressing; Journal of General Microbiology (1983), 129, 2307-2314.)

In U.S. Patent No. 3,912,490, Malcolm B. Boghosian discusses the use of urea peroxide and hydrogen peroxide as supplements to fertilizers which release oxygen to the soil.

The Boghosian composition is an aqueous solution containing urea peroxide or hydrogen peroxide.

This solution is applied to the soil or other media in which the plant grows and it penetrates the soil, releasing oxygen to the root zone.

This oxygen treatment improves plant appearance and prevents injury to the plant due to over watering.

Calcium peroxide, potassium peroxide, and magnesium peroxide are better oxygen release agents than the urea peroxide and hydrogen peroxide used by Boghosian.

These metal peroxides may be applied directly to the soil either in dry powder form or dispersed in water, dissolved or dispersed in water and applied to seeds prior to planting, or compounded with nutrients to provide a fertilizer having an active amount of the calcium peroxide, potassium peroxide, magnesium peroxide, or mixtures thereof.

One of the continued challenges in engineering clinically applicable tissues is the establishment of vascularization upon implantation in vivo.
Although the effectiveness of an enhanced angiogenic response using various growth factors has been demonstrated in many tissue systems, the rate of angiogenesis could not be accelerated.

In this study we investigated whether incorporating oxygen generating biomaterials into tissue engineered constructs would provide a sustained oxygen release over an extended period of time.

We examined whether oxygen generating biomaterials are able to maintain cell viability while also maintaining structural integrity of a 3-D construct.

Calcium peroxide-based oxygen generating particles were incorporated into 3-D scaffolds of Poly(d,l-lactide–co–glycolide) (PLGA).

The scaffolds were designed to generate oxygen over the course of 10 days and simultaneously maintain sufficient mechanical integrity.

Scaffolds containing oxygen generating materials maintained elevated levels of oxygen when incubated under hypoxic conditions.

Further, these biomaterials were able to extend cell viability growth under hypoxic conditions.

These findings indicate that the use of oxygen generating biomaterials may allow for increased cell survivability while neovascularization is being established after implantation.

Such scaffolds may play an important role in tissue engineering where currently oxygen diffusion limits the engineering of large tissue implants. (Se Heang Oh, Catherine L. Ward, Anthony Atala, James J. Yoo and Benjamin S. Harrison; Oxygen generating scaffolds for enhancing engineered tissue survival; Biomaterials Volume 30, Issue 5, February 2009, Pages 757-762)

This research investigates the use of a proprietary formulation of calcium peroxide as an oxygen releasing compound in a treatment wall.

Laboratory scale column studies evaluated the release of oxygen and the permeability effects resulting from a mixture of the calcium peroxide and representative aquifer sand (40-mesh Unimin sand).

Influent water was prepared at an average dissolved oxygen concentration of 3.1 mg/L and pumped into the treatment wall soil at a constant rate of 0.17 cm³/s to simulate ground water dissolved oxygen and flow conditions.

The average changes in relative permeability for mixtures of 0.1%, 0.5% and 1.0% calcium peroxide by weight were 65.6%, 66.1% and 77.1%, respectively.

The peak dissolved oxygen levels in the same mixtures were 5.9, 7.40, and 10.7 mg/L, respectively. (Lizette Chevalier and Charles D. McCann ; Feasibility of calcium peroxide as an oxygen releasing compound in treatment walls; International Journal of Environment and Waste Management; Volume 2, Number 3 / 2008; Pages: 245 – 256)

Calcium peroxide, when injected in slurry form at optimal locations, will release oxygen beneath the water table thereby stimulating biodegradation of the aromatic hydrocarbons in ground water.

The by-products from the reactions are water, carbon dioxide, and calcium ions.

Laboratory experiments have been conducted to assess the performance of the food-grade calcium peroxide as an oxygen source.

Calcium peroxide generated maximum dissolved oxygen levels of 20 to 40 ppm with pH levels at the source ranging from 10 to 12.

The sandy soil used in the experiment had sufficient buffering capacity to neutralize the elevated pH levels within a few feet from the source.

The total dissolved solids did not exceed 500 mg/L. (http://www.dep.state.fl.us/waste/quick_topics/publications/pss/pcp/innovative/variances/v_0008.doc)

Growth enhancement by drainage during seedling establishment was compared with seed coating with calcium peroxide in rice direct-sown into puddled and leveled soil.

Coated and noncoated seeds were sown about 10 mm deep, three times from April to June at two locations (Niigata and Ibaraki, Japan).

Seed coating with calcium peroxide accelerated seedling emergence at an early stage, whereas drainage during 10 to 13 days after sowing promoted it at a late stage.

Although drainage was less effective in increasing the number of finally emerged seedlings than seed coating with calcium peroxide, the drainage clearly improved seedling establishment.

Seed coating with calcium peroxide enhanced shoot elongation during seedling emergence.

In contrast, drainage somewhat inhibited shoot elongation at this time, but promoted it after drained soil was flooded.
Drainage also increased the dry weight of shoots more than flooding after seedling emergence. These results indicate that seed coating with calcium peroxide enhances plant growth during seedling emergence, whereas drainage after sowing promotes plant growth mainly after seedling emergence. This suggests that seed coating with calcium peroxide accelerates seedling emergence, but drainage after sowing enhances seedling establishment. (http://www.jstage.jst.go.jp/article/pps/7/3/7_324/_article)

In Swine rearing:
- To deodorize swine manure along with minced horseradish (Armoracia rusticana L) roots (1:10 w/v plant tissue to swine slurry ratio, OXYFORTE at 26 or 34 mM)

In oceans
- OXYFORTE facilitates to remove the oceanic or lacustrine red tides.
- By adding 100 mg~500 mg of OXYFORTE per Liter of water, the occurrence of red tide can be eliminated in 24 hours.

Application method:

For Improving Soil Aeration
- 1 Kg per Acre at land preparation / sowing for field crops.
- 2-3 gm per plant once in six months for orchard crops.
- Can be mixed with other fertilizers for soil applications.

For improving hydraulic conductivity
- Normal plants: Flood irrigate after diluting with water for 2,000-5,000 times.
- Orchids: Flood irrigate after diluting with water for 5,000-8,000 times.

Sprinklers system to facilitate reaching into root zone:
- OXYFORTE was applied through the irrigation micro sprinkler system at the rate of 1-2 kg per acre.
- Slurry of water and OXYFORTE was mixed at a ratio of 20: 1 and maintained under constant agitation.
- Then the slurry was injected into the irrigation system under standard irrigation flow rates and pressures.
- Following the OXYFORTE application the sprinklers ran for about 1 hr washing the material through the leaf litter to the root zone.
- The OXYFORTE appeared to be washed down or watered into the root zone of the plants.

IN THE CASE OF PLANTING LARGE TREES LIKE AVOCADO TO PREVENT ROOT ROT etc.

Treatment was as follows for each tree: OXYFORTE 10-20 gm /tree

Planting protocol is as follows:
- The soil for the trees was removed from a 12" wide by 18" deep planting hole and placed in a wheelbarrow.
- OXYFORTE in the amounts prescribed above were then mixed into the planting- hole soil.
- One shovel full of the soil/treatment mixed material was returned to the bottom of the planting hole.
- The tree was placed in the hole.
- The soil/treatment mixed material was placed in the hole around the root ball, filling the hole to 2/3rds of the hole.
- This material was compacted and 5-10 L of the root dip water was added to the hole.
- The remaining material was then added filling the hole and compacted.
- Following compaction 5-10 L of the root dip water was added to the final planting mound.
- 2 m support poles were driven in next to the tree trunk and the tree was secured to the stake via plastic support tape.
- Mulching wood chips were added in 0.5 m wide band around the planted tree.
- Mini-sprinkler irrigation head was placed about 30 cm from the trunk.
Application of calcium peroxide in Aquaculture:

1. **Adjusting pH value;** Calcium peroxide is approved to be efficient in improving the subaqueous pH value and prevent water from acidification.
2. **Eliminating carbon dioxide and sulfurred hydrogen;** In a pond covered with a ice cap, carbon dioxide usually exists in a big quantity and hinders the oxygen absorption of fishes. Calcium peroxide shows a great effect on elimination carbon dioxide. Calcium peroxide can remove sulfured hydrogen during its oxygen release process, this improve the water quality at the lower part.
3. **Preventing anaerobe from proliferation and killing nosogenetic bacteria, defecating aqueous body;** Calcium peroxide is an oxidizer than acts as a disinfectant which may efficiently kill ananerobe and nosogenetic bacteria. Calcium peroxide may facilitate depositing floccules and clearing turbid water thus improves the photosynthesis of natant foliage to increase dissolved oxygen.
4. **Providing sufficient dissolved oxygen;** This is typically useful for increasing the unit production by enhancing the breeding density at a limited area and solving the problem of oxygen-lacking in some seasons especially winter. Unlike other oxygen release chemicals that release oxygen rapidly, calcium peroxide provides a stable and continued source of oxygen thus it is considered an economical oxygen source for extensive aquaculture applications.
5. **Reducing the subaqueous content of ammonium and nitrogen;** Ammonium and nitrogen are major factor that prevents fishes from developing, by disseminating calcium peroxide into water, the ammonium and subaqueous content can be remarkably reduced. When dissolved in water, calcium peroxide breaks down into calcium hydroxide, oxygen and water. This characteristic gives calcium peroxide a function as the conditioner of water quality which provides a comfortable environment for aquatic life breeding like fishes, shrimps and crabs.

The benefits for application of calcium peroxide in aquaculture embody in following aspects.

Dosage of calcium peroxide for oxygen-lacking pond

<table>
<thead>
<tr>
<th>Depth, m</th>
<th>Dosage, kg/666.6 m²</th>
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<tbody>
<tr>
<td>1</td>
<td>2-3</td>
</tr>
<tr>
<td>1.5</td>
<td>3-4</td>
</tr>
<tr>
<td>2</td>
<td>4-5</td>
</tr>
<tr>
<td>2.5</td>
<td>5-6</td>
</tr>
<tr>
<td>3</td>
<td>6-8</td>
</tr>
</tbody>
</table>

For control of anaerobic microorganisms and to improve D.O. and to control BOD and COD in Aqua Ponds

1 Kg per Acre once a week in Aquaculture ponds

I. Active ingredient

I.1. Product chemistry

I.1.1. Active ingredient

<table>
<thead>
<tr>
<th>Common name:</th>
<th>Calcium Peroxide</th>
</tr>
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<tbody>
<tr>
<td>Molecular Formula:</td>
<td>CaO₂</td>
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CLASSIFICATION:

<table>
<thead>
<tr>
<th>CAS NO.:</th>
<th>1305-79-9</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE (EINECS) NO. :</td>
<td>215-139-4</td>
</tr>
<tr>
<td>CE Class:</td>
<td>Xi-O; R8-R41</td>
</tr>
<tr>
<td>RTECS:</td>
<td>EW3865000</td>
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<tr>
<td>TSCA:</td>
<td>TSCA 8(b) inventory:</td>
</tr>
<tr>
<td>DOT HAZARD CLASS:</td>
<td>5.1 (Oxidizer)</td>
</tr>
<tr>
<td>RCRA Waste Number:</td>
<td>D001, ignitable</td>
</tr>
<tr>
<td>SARA Section:</td>
<td>311/312 hazard category: Fire hazard and immediate health hazard.</td>
</tr>
</tbody>
</table>
Classification and labelling

Canada. Canadian Environmental Protection Act (CEPA). WHMIS Ingredient Disclosure List
(Can. Gaz., Part II, Vol. 122, No. 2)
- C Oxidizing Material
- D2B Toxic Material Causing Other Toxic Effects

Hazard Codes: O,Xi,C

Federal and State Regulations:
New Jersey: Calcium peroxide
TSCA 8(b) inventory: Calcium peroxide

Other Regulations:
OSHA PEL-TWA:
- SAEL (Solvay Acceptable Exposure Limit) 2007 TWA = 3 mg/m³
OSHA PEL-STEL: Not listed.
OSHA PEL-Ceiling: Not listed.
EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Regarding Calcium Hydroxide:
ACGIH: 5 mg/m³ (TWA)
OSHA: 5 mg/m³ (PEL) (respirable fraction) 15 mg/m³ (PEL) (total dust)

Other Classifications:

HMIS = Hazardous Materials Identification System
Degree of Hazard Code:
4 = Severe
3 = Serious
2 = Moderate
1 = Slight
0 = Minimal

WHMIS (Canada):
CLASS C: Oxidizing material.
CLASS D-2B: Material causing other toxic effects (TOXIC).
DSCL (EEC):
R37/38- Irritating to respiratory system and skin.
R41- Risk of serious damage to eyes.

WHMIS (U.S.A.):
Health Hazard: 3
Fire Hazard: 0
Reactivity: 2
Personal Protection: E

NFPA (National Fire Protection Association)
Degree of Hazard Code:
4 = Extreme
3 = High
2 = Moderate
1 = Slight
0 = Insignificant

National Fire Protection Association (U.S.A.):
Health: 3
Flammability: 0
Reactivity: 2

INTERNATIONAL LISTINGS
Calcium peroxide:
Australia (AICS): Listed
China: Listed
Japan (ENCS): (1)-190
Korea: KE-04597
Philippines (PICCS): Listed
New Zealand: Listed

Calcium hydroxide
Australia (AICS): Listed
China: Listed
Japan (ENCS): (1)-181
Korea: KE-04518
Philippines (PICCS): Listed
New Zealand: Listed

Specific hazard:

Protective Equipment:
Gloves.
Lab coat.
Dust respirator.
Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

SYNONYMS: Calcium Superoxide, Calcium dioxide, Miture of Calcium dioxide, Calcium oxide and Calcium hydroxide

Composition: CaO$_2$, CaO, Ca(OH)$_2$

Molecular weight: 72.08

Appearance, color, odor, physical state: White or yellowish powder

Boiling point: at 1 atm: Decomposes

Melting point: 365 (Decomposes)

Heat of Decomposition: $-135$ Btu/lb $= -75$ cal/g $= -3.1 \times 10^5$ J/kg

Reid Vapor Pressure: Currently not available

Bulk Density: 0.91 ± 0.05

Solubility in water and organic solvents
In Water at 20 Deg C: <0.01%
Insoluble in water and slowly decomposed by water to produce calcium hydroxide (slaked lime) [Sax, 9th ed., 1996, p. 636].

Viscosity (liquid form): Not Pertinent
Polymerization: Not pertinent
Inhibitor of Polymerization: Not pertinent

Hydrolysis: Non-significant hydrolysis

Photolysis: Photolysis is part of the light-dependent reactions of photosynthesis.

I.1.2. Technical product

Composition:

Name and content of the active ingredient, impurities, name and rate of the isomer

AI: Calcium Peroxide
Assay: ≥75%
Moisture: 2.0%

IMPURITIES

Calcium Oxide: CAS-No.: 1305-78-8
Concentration: ≥5.0 - ≤15.0%

Calcium Hydroxide: CAS-No.: 1305-62-0
Concentration: ≥5.0 - ≤15.0%

Other inorganic Calcium Carbonate: CAS-No.: 471-34-1
Concentration: ≥5.0 - ≤10.0%

Appearance, color, odor, state: White or yellowish fine powder

Density, Viscosity (liquid form) of AI: 0.91 ± 0.05

pH(1% suspension): 11.7+/− 0.5

Specification of AI

Assay: ≥75%
Moisture: 2.0%
Manufacturing process
Reactor SS with Chilled brine water in Jacket and equipped with a stirrer and vent were used. Vent pipe was of 25 m in height.
CaO (burnt lime) 90% purity 400 Kg is charged and 50% H2O2 is slowly added with constant agitation and brine solution under circulation. When the reaction is over, material is still kept under agitation and vent kept open till all the waste gases are expelled. Then vent is closed and the material is recovered and pulverized for uniform size and packed in asceptic conditions.

Analytical method
MATERIALS:
Reagents
HCl
H2O2
KMnO4

Instruments
Nil

Equipment requirements
Titration equipment like burettes, pipettes, conical flasks

METHODOLOGY
Titration SI-Hö/AA-Nr.: 8.3

Permanganate Method:
1. dissolve CaO2 in acid to release H2O2
CaO2 + 2H+ →Ca2++ H2O2
2. quantify H2O2 by titration with KMnO4
5H2O2 + 6H+ +2KMnO4 → 2K+ + 2Mn2++ 8H2O + 5O2
3. calculate %CaO2 from H2O2 concentration
AATCC Test Method 102 2007 102-H2O2: KMnO4:

Precision of the method
The relative standard deviation of the method was found to be +/- 2%

QUALITY CONTROL relating to Contents of active ingredient, of toxic impurity,
Anything below the standards given below are rejected

Assay: ≥ 75%
Moisture: NMT 2 %

IMPURITIES
Calcium Oxide
CAS-No.: 1305-78-8
Concentration: >= 5,0 - <= 15,0 %

Calcium hydroxide
CAS-No.: 1305-62-0
Concentration: >= 5,0 - <= 15,0 %

Other inorganic Calcium Carbonate
CAS-No.: 471-34-1
Concentration: >= 5,0 - <= 10,0 %

I.2. Toxicology
Toxicity class WHO: II

WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE for 100% GRADE.

EYE EFFECTS: Severely irritating to unwashed eyes.
Minimally irritating to washed eyes. (rabbit) [Ref. FMC I88-1053]

SKIN EFFECTS: Non-irritating (rabbit) [FMC Ref. I88-1054]

DERMAL LD50: > 10 g/kg (rat) [FMC Study Number: ICG/T-79.026]

ORAL LD50: > 5 g/kg (rat) [FMC Ref. I88-1052]

INHALATION LC50: > 17 mg/l (1 h) (rat) [FMC Ref. ICG/T-79.026]

TARGET ORGANS: Eyes and respiratory passages

Acute toxicity of the dust (LC50): 68000 mg/m3 4 hour(s) [Rat].

Skin Absorption:
No significant hazard (rabbit).

Sensitization
- Guinea pig, Did not cause sensitization on laboratory animals.

Genetic toxicity in vitro
- In vitro tests did not show mutagenic effects

Remarks
- Risk of serious damage to eyes.

Limits for calcium hydroxide are as given below:

OSHA/PEL-TWA= 5mg/m3
ACGIH/TLV-TWA= 5mg/m3

Potential Acute Health Effects:
Extremely hazardous in case of skin contact (irritant), of eye contact (irritant)
Very hazardous in case of ingestion, of inhalation (lung irritant)
Hazardous in case of skin contact (corrosive)
Prolonged exposure may result in skin burns and ulcerations.
Over-exposure by inhalation may cause respiratory irritation.
Inflammation of the eye is characterized by redness, watering, and itching.
Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS:
NTP: Not listed
IARC: Not listed
OSHA: Not listed
OTHER: ACGIH: Not listed

MUTAGENIC EFFECTS: In vitro tests did not show mutagenic effects
TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Not available.
REPRODUCTIVE TOXICITY: According to the information presently available to the New Jersey Department of Health and Senior Services, Calcium Peroxide has not been tested for its ability to affect reproduction.

Repeated or prolonged exposure is not known to aggravate medical condition.

Effect on suckling and lactating dams:
Not determined

Irritation to Mucous membrane:
Irritating to mucous membrane and eyes; Irritating to the respiratory tract.

Neurotoxicity in Hens: No Neuro-toxic effect at the recommend dosage

I.3. Residue and effect on human
No occupational exposure limits have been established for Calcium Peroxide. This does not mean that this substance is not harmful. Safe work practices should always be followed.

Metabolism in animal and human body
Asthmatics and people with a history of allergies are to avoid nearness to this. Calcium Peroxide is able to decrease the number of living cells of pathogens in addition to influencing metabolism of pathogenic bacteria and their toxin yields.

Metabolism and degradation in plant, soil:
Calcium peroxide helps in bioremediation /bioaugmentation of the Soil and water by degrading the contaminants by improving the survival and performance of several aerobic beneficial microorganisms.
By providing oxygen into the subsoil, Calcium peroxide enhances the biodegradation activity of aerobic bacteria. It results in an enhanced aerobic biodegradation of many organic compounds.
In the presence of sufficient oxygen (aerobic conditions), and other nutrient elements, microorganisms will ultimately convert many organic contaminants to carbon dioxide, water, and microbial cell mass.
(http://www.remediation-soil.com/processes/enhancedbio/0,,51618-2-0,00.htm)

Residue data from other countries:
Not Available

Residue analytical method on crops:
Calcium peroxide has also been used in converting crop residue into cattle feed. It is possible to treat straw, cornstalls, corn cobs, soy bean residue, sawdust or even ground up brush with a weak solution of calcium peroxide in order to convert them into animal feed.
Since calcium peroxide amounts involved are about 1-2 Kg of 60% purity / Acre or say about 5 Tons total biomass and availability of the calcium peroxide is around 60% and the calcium peroxide is degraded in about 6 months, residues in the crop harvested will be around 1.2g/50 Kg yield approximately +/- 15-30%, which are considered tolerable.

Fatty tissue accumulation:
Not pertinent. Not determined. No dietary exposure is expected from the bioagri input uses of calcium peroxide since no food or feed uses are registered.
Not suspected to be bioaccumulative Ref: Environment Canada Domestic Substance List

Max Residue Limit (MRLs):
Not Pertinent
Acceptable daily intake (ADI): None determined. No dietary exposure is expected from the bioagri input uses of calcium peroxide since no food or feed uses are registered. Designated as safe for general or specific, limited use in food. Ref: FDA Food Additive Status Designated as safe for general or specific, limited use in food. Ref: FDA Everything Added to Food

Pre-harvest interval (PHI) (into finished product): 24 Hours

I.4. Effect on environment

I.4.1. Environment fate
Not suspected to be an environmental toxin. Ref: Environment Canada Domestic Substance List

Volutility: Low

Absorption in the soil: It has minimal tendency to bind to soil or sediment

Leaching- GUS leaching potential index:
Not pertinent

Soil degradation and Hydrolysis:
Abiotic degradation in soil: complexation/precipitation of inorganic materials
Degradation in water: non-significant hydrolysis

Photolysis DT50 (days) at pH 7:
Photolysis is part of the light-dependent reactions of photosynthesis.

I.4.2. Effect on non-target organisms

Effect on bird, bee, wild animals
Not Available

Effect on fish, aquatics

Acute toxicity
- Fishes, Cyprinus carpio, LC50, 48 h, 160 mg/l
- Crustaceans, Daphnia sp., EC50, 24 h, 25.6 mg/l

Effect on natural enemies: Not Available

II. Formulation

II.1. Product chemistry

Trade name: OXYFORTE

Formulation type: Free flowing Powder
Composition: content, solvent, additive

On Dry Basis

Active Ingredient of 75%
Moisture: 5-8%
No Solvents
No additives.

Appearance, color, odor, physical state: White to yellowish powder.

Bulk Density: 0.91 ± 0.05

Flammability: Not flammable, but may cause fire on contact with combustible material.
**Flash Point:** Not flammable, but may cause fire on contact with combustible material.

**Adiabatic Flame Temperature:** Currently not available

**Explosiveness:**
- Under fire conditions, product may decompose and release oxygen gas that supports combustion.
- Mixtures with polysulphide polymers may ignite.
- Calcium peroxide is an explosion hazard if mixed with finely divided organic matter.
- Noncombustible but accelerates the burning of combustible material: mixtures of combustible material and the peroxide can be ignited by friction or contact with moisture.
- Mixtures with polysulfide polymers may ignite.
- Decomposes rapidly above 200° C.
- Strongly basic Reacts with water to produce calcium hydroxide (slaked lime) [Sax, 9th ed., 1996, p. 636]

**Combustion Molar Ratio (Reactant to Product):** Not Pertinent

**Corrosiveness:** Non-corrosive in presence of glass.

**Compatibility with other pesticides:** May oxidize the pesticides

**Materials to be avoided:** Water, Acids, Bases, Heavy metal salts, Reducing agents, Organic materials, Flammable materials

**Production process:**
- Active Ingredient which is passed in QC and the inert ingredient are weighed individually as per the desired ratios with sufficient overages and blended in a batch type horizontal SS ribbon blender for more than 1 Hour and packed in aseptic conditions

**Specification**
Active Ingradient of 60 
Moisture: 5-8%

**Properties**

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Result</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description (appearance)</td>
<td>White to yellow free flowing</td>
<td>Visual</td>
</tr>
<tr>
<td>Calcium Peroxide</td>
<td>NLT 75%</td>
<td>Titration</td>
</tr>
<tr>
<td>Suspensibility</td>
<td>Not applicable</td>
<td>Visual</td>
</tr>
<tr>
<td>Particle size distribution</td>
<td>Through 80 mesh</td>
<td>Min 99%</td>
</tr>
<tr>
<td></td>
<td>Through 120 mesh</td>
<td>Min 35%</td>
</tr>
<tr>
<td>Solubility</td>
<td>In Water at 20 Deg C :</td>
<td>&lt;0.01% (Calcium hydroxide)</td>
</tr>
<tr>
<td>Insoluble in water and slowly decomposed by water to produce calcium hydroxide (slaked lime) [Sax, 9th ed., 1996, p. 636].</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Foam when mixed water** NA

**Stability at 50 degrees C:** Stable

**Major Contaminants that contribute to instability:** Heat, moisture, reducing agents

**Active Ingredient:** Calcium Peroxide 60%

**Storage and shelf life:**
- Store in a dry location away from heat and out of direct sunlight in containers fitted with a safety valve or vent. Storage temperature: <104°F (40°C).
- Store in an area away from acids, bases, metals, metal salts, reducing agents, organic materials or flammable substances.
- Do not store near or expose to heat sources (ie: steam pipes, radiant heaters, hot hair vents or Welding sparks)
- Never return unused product to the storage container.
- Rotate inventories - first in, first out.

NFPA Hazard Class 1 Oxidizer
IMCO Hazard Class 5.1 Oxidizer

A Listing of Reported Calcium Peroxide Decomposition Products
Decomposition: > 200 °C, rapidly liberates oxygen
Contact with water: Decomposes into hydrogen peroxide and slaked lime

First aid
If in eyes: Hold eye open and rinse slowly and gently with water for 15-20 minutes.
Remove contact lenses, if present, after first 5 minutes, then continue rinsing eye.
Call a poison control center or doctor for treatment advice.

If on skin or clothing:
Take off contaminated clothing.
Rinse skin immediately with plenty of water for 10-15 minutes.
Then use non-abrasive soap and large amounts of water for another 10-20 minutes.
Be particularly careful to clean folds, crevices, creases and groin.
Call a poison control center for treatment advice.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

If swallowed:
Call poison control center or doctor immediately for treatment advice.
Have person sip a glass of water if able to swallow.
Do not induce vomiting unless told to do so by the poison control center or doctor.
Do not give anything by mouth to an unconscious person.

If inhaled:
Move person to fresh air.
If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably by mouth-to-mouth, if possible.
Call a poison control center or doctor for treatment advice.

Notes to Physician:
Modest irritation is only expected effect and should have no serious consequences except in the case of direct eye contact.
If ingested, gastrointestinal irritation is to be expected.
If large quantities are ingested, gastric evacuation via emesis or lavage may be used.
Demulcents should be helpful. No systemic effects are expected.
Have the product container or label with you when calling a poison control center or doctor, or going for treatment.

Analytical methods:
MATERIALS:
Reagents
HCl
H₂O₂
KMnO₄

Instruments
Nil

Equipment requirements
Titration equipment like burettes, pipettes, conical flasks
METHODOLOGY
Titration SI-Hö/AA-Nr.: 8.3

Permanganate Method:
1. Dissolve CaO₂ in acid to release H₂O₂
   \[ \text{CaO}_2 + 2\text{H}^+ \rightarrow \text{Ca}^{2+} + \text{H}_2\text{O}_2 \]

2. Quantify H₂O₂ by titration with KMnO₄
   \[ 5\text{H}_2\text{O}_2 + 6\text{H}^+ + 2\text{KMnO}_4 \rightarrow 2\text{K}^+ + 2\text{Mn}^{2+} + 8\text{H}_2\text{O} + 5\text{O}_2 \]

3. Calculate %CaO₂ from H₂O₂ concentration
   AATCC Test Method 102 2007 102-H₂O₂: KMnO₄:

Precision of the method
The relative standard deviation of the method was found to be +/- 2%

QUALITY CONTROL relating to Contents of active ingredient, of toxic impurity,
Anything below the standards given below are rejected
Assay: \( \geq 60\% \)
Moisture: NMT 8 %

IMPURITIES
Calcium Oxide
CAS-No.: 1305-78-8
Concentration: \( \geq 5,0 \) - \( \leq 20,0 \) %

Calcium hydroxide
CAS-No.: 1305-62-0
Concentration: \( \geq 5,0 \) - \( \leq 20,0 \) %

Other inorganic Calcium Carbonate
CAS-No.: 471-34-1
Concentration: \( \geq 5,0 \) - \( \leq 15,0 \) %
(Reports from RADOSOM)

II.2. Biological Particularity

Mode of action
When in contact with water it will immediately begin to decompose releasing oxygen.
Calcium peroxide is composed of oxygen being held in a tight bond with calcium, both of which are indispensable when growing high-performance crops.
The breakdown is as follows: \( \text{CaO}_2 \rightarrow \text{Ca}^2+ + \text{H}_2\text{O}_2 \)
As mentioned previously H₂O₂ decomposes into 1,H₂O and 1, O.

Unbuffered-Ca(OH)₂ drives pH>12: \( 2\text{CaO}_2(s) + 2\text{H}_2\text{O} \rightarrow 2\text{Ca(OH)}_2(s) + \text{O}_2 \)

Low pH (buffered or acidified): \( \text{CaO} \ 2(s) + 2\text{H}^+ \rightarrow \text{Ca}^{2+} + \text{H}_2\text{O} \)

As pH drops, yield more H₂O₂ & less O₂

Efficacy data from other countries: Not Available

Safe in use: Generally considered as safe

II. 3. Toxicology

Toxicity class WHO: II

WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE for 100% GRADE.
EYE EFFECTS: Severely irritating to unwashed eyes. Minimally irritating to washed eyes. (rabbit) [Ref. FMC I88-1053]
SKIN EFFECTS: Non-irritating (rabbit) [FMC Ref. I88-1054]
DERMAL LD50: > 10 g/kg (rat) [FMC Study Number: ICG/T-79.026]
ORAL LD50: > 5 g/kg (rat) [FMC Ref. I88-1052]
INHALATION LC50: > 17 mg/l (1 h) (rat) [FMC Ref. ICG/T-79.026]
TARGET ORGANS: Eyes and respiratory passages
Acute toxicity of the dust (LC50): 68000 mg/m3 4 hour(s) [Rat].

Skin Absorption:
No significant hazard (rabbit).

Sensitization
- Guinea pig, Did not cause sensitization on laboratory animals.

Genetic toxicity in vitro
- In vitro tests did not show mutagenic effects

Remarks
- Risk of serious damage to eyes.

Limits for calcium hydroxide are as given below:
OSHA/PEL-TWA= 5mg/m3
ACGIH/TLV-TWA= 5mg/m3

II.4. Effect on non-target organisms
Effect on bird, bee, wild animals: Not available

Effect on fish, aquatics:
Acute toxicity
- Fishes, Cyprinus carpio, LC50, 48 h, 160 mg/l
- Crustaceans, Daphnia sp., EC50, 24 h, 25.6 mg/l

Effect on natural enemies:
Not Available