HYDROGEN PEROXIDE INACTIVATION

- Increase workplace safety
- Create less waste
- Lower the costs of spills and leaks

NSF Nonfood Compounds Program Listed (J1) #152371

OH&S 2015 New Product of the Year

NAE 250 Award Winner 2016

OMRI Listed For Organic Use

SpillFix®

Environmentally responsible solutions for a safer workplace

Dalton International Ltd

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SUMMARY

Absorption and chemical inactivation of hydrogen peroxide and peroxyacetic acid by SpillFix.

The ability of SpillFix®, a coir based product, to contain and inactivate a solution of Oxonia Active was compared with that of three other chemical absorbents –perlite, zeolite and cotton waste.

SpillFix® was clearly superior in most of the measured parameters.

The material excels in the following areas:

1. High water holding capacity – will contain more chemical than other materials tested.
2. Readily rewet – minimum agitation needed to soak up spills.
3. Inactivates peroxide and peroxyacetic acid – reaction is safe.
4. Color reactive - Changes to a bright orange after absorbing the chemical.
5. Light weight – Low bulk density means that the product can be handled easily and safely.
6. Not dusty – Minimum inhalation hazard.
7. Natural product – SpillFix is manufactured from a certified organic and renewable material.

AIM

The purpose of the experimental work reported here was to compare and contrast the absorption and inactivation of hydrogen peroxide and peroxyacetic acid by SpillFix® with three other materials used to contain and control chemical spills.

TEST PROCEDURE

A solution containing hydrogen peroxide and peroxyacetic acid was prepared from a food grade sterilizing agent sold as Oxonia Active. This was used at a rate of 2ml of concentrate in a liter of water.

Oxonia Active contains 10-30% hydrogen peroxide and <10% peroxyacetic acid and is manufactured by Ecolab of Castle Hill, Sydney.

The chemical absorbents used in the study were:

1. SpillFix® – A product manufactured by Galuku from coir dust.
2. Perlite – Fine grade perlite.
3. Zeolite – A chalky zeolitic rock possibly clinoptilolite.
4. Cotton waste – A dust like material.

A 140ml volume of each absorbent material was placed in a clear plastic Chinese food container. Each treatment was replicated by five containers. 15ml of the diluted Oxonia solution was then dispensed into each container and mixed through the chemical absorbent.

At intervals, a single container from each treatment was removed to test the activity of the absorbed solution. A sample of the diluted Oxonia test solution was also collected at this time to monitor its stability.

Extraction Procedure

A slurry was made by mixing140ml of water with the treated absorbing material. After 5 minutes, the slurry was filtered and the resulting solution tested for peroxide and peroxyacetic acid.

Testing Procedure

The concentration of hydrogen peroxide and peroxyacetic acid in the extracts was determined using the Merck Environmental Reflectoquant system. This method is based on color reactive test strips which are read with a reflectometer.

COMPARATIVE RESULTS

Physical Characteristics

The fine perlite and the cotton waste material were very dusty and unpleasant to handle. Gloves and particle mask would be required to reduce the hazard from inhalation.

This was not a problem with the coir and the zeolite materials. However, the chalky nature of the zeolite means that it could leave a powdery residue on a rough surface such as a concrete floor. The residue would be easily removed with a brush and water and so would not be a major consideration in many applications.

Table: 1 – The materials varied in bulk density

Moist bulk density of each material

Material	Bulk Density (g/ml)
Coir	0.21
Perlite	0.14
Zeolite	0.63
Cotton Waste	0.43

Perlite and coir were significantly lighter than the other two materials. The heaviest product was zeolite.

Absorption

The coir, perlite and zeolite based products all quickly absorbed the test solution without the need for mixing. On the other hand, the cotton waste material was water repellent and tended to float on the surface of the test solution. Vigorous mixing was required to ensure the chemical solution was fully absorbed. In an industrial situation, the repellency could be overcome by sweeping the material back and forth over the spill. However, the action would increase the exposure of personal to fumes which would be undesirable with some chemicals.

The capacity of each material to hold water was estimated by measuring the water content of the saturated material collected after filtering. This was done by comparing the weight of the material when it was fully wet with that after oven drying (Table 2).

Table: 2 – Capacity of each material to hold the test solution (Saturated water holding capacity)

Material	Wet Weight (g)	Dry Weight (g)	Water Content	
			ml	%v/wt
Coir	136	31	105	77
Perlite	130	34	96	74
Zeolite	193	104	89	46
Cotton Waste	183	66	117	64

ABSORPTION & INACTIVATION

The results of this simple test show that the coir and the perlite materials hold more water on a weight basis than either the cotton waste or the zeolite. By this measure, the zeolite holds the least water.

Inactivation with Oxonia

Oxonia is a strong oxidizing agent and will react with organic materials. Consequently it was expected that the coir and cotton waste absorbents would to some degree inactivate the liquid on contact. Thus in addition to containing a spill these materials might also help to reduce the hazard it represents.

Perlite was not expected to inactivate Oxonia to any great extent because of its glass like nature which makes it relatively chemically inert. For similar reasons, little inactivation was expected from the zeolite.

As an initial safety check, I measured the heat generated when different volumes of Oxonia concentrate were applied to coir in a plastic vessel. The results of this experiment are given in Table 3.

Table: 3 – Temperature increase from the reaction between SpillFix and Oxonia

Weight of Coir	Oxonia (ml)	Temperature (°C)
26g	0	21.4
26g	10	22.7
26g	20	29.3
26g	30	27.6
26g	40	31.9
26g	50	30.2

A temperature increase was recorded in this experiment which confirmed that the concentrated Oxonia solution reacted with the coir. Furthermore, the reaction proved not to be violent nor did it produce any unpleasant odors or fumes.

The maximum temperature increase recorded when the concentrate was applied to the coir was 10°C and the maximum temperature reached in the reaction was 31.9°C.

REACTION RESULTS

The reaction produced a striking change in the color of the coir. Within seconds of contact with the chemical, the coir turned from a dark brown to a bright orange (See plate 1).

Plate: 1

This color response could prove to be a useful characteristic of the product as:

- A visual warning of the reactivity and location of the chemical. This would reinforce the potential danger of coming in contact with the chemical. It would also encourage greater care when handling or disposing of orange colored coir.

- An aide to ensure a spill is completely moped up. Unreacted brown coir can be swept into the spill and more coir may be applied when the product is fully reacted. Suspicious liquid can be tested and absorbed.

Plate 1 Orange color of coir after reaction with concentrated Oxonia. Brown material on right has not come in contact with the chemical. Tests performed using a working strength (2ml/L) Oxonia solution demonstrated that all the absorbing materials inactivated the chemical to some degree.

Coir, zeolite, cotton waste and perlite all reduced the concentration of hydrogen peroxide in the treatment solution (Figure 1). The most rapid inactivation of peroxide was achieved with coir and the least was obtained with perlite.

INACTIVATION RESULTS

Figure: 1 – Inactivation of peroxide by absorbing material

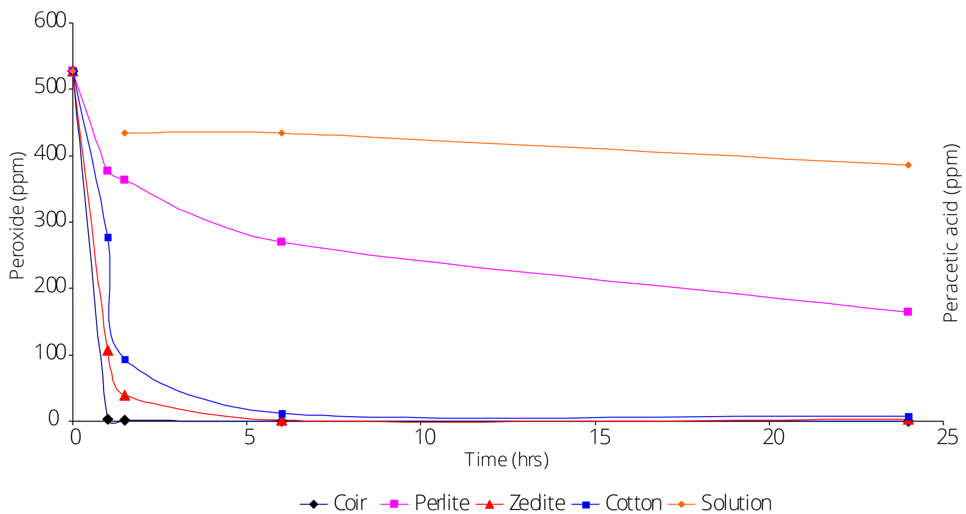
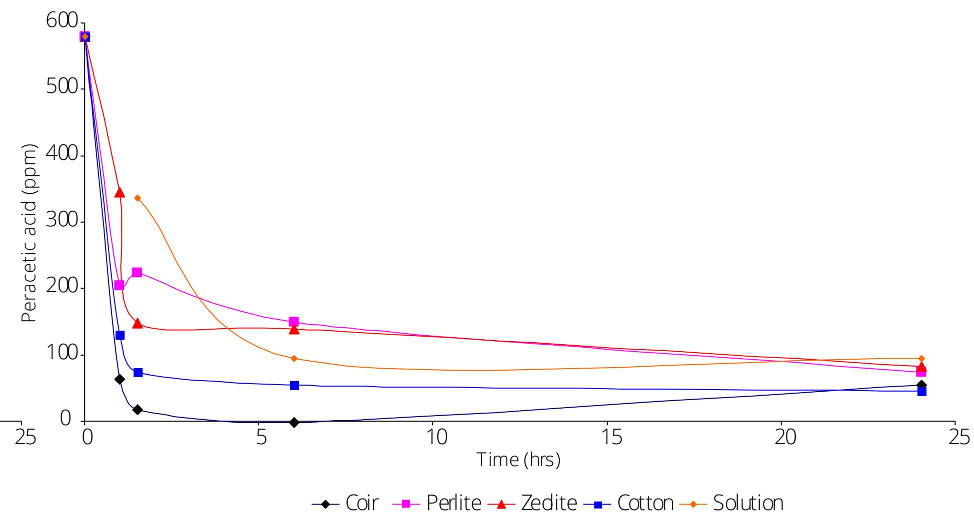


Figure: 2 – Inactivation of peracetic acid by absorbing material



Coir, zeolite, cotton waste and perlite all reduced the concentration of hydrogen peroxide in the treatment solution (Figure 1). The most rapid inactivation of peroxide was achieved with coir and the least was obtained with perlite.

Inactivation of peroxyacetic acid was also accelerated in the presence of the absorbing material (Figure 2). Once again coir produced the fastest and most complete inactivation.

Peroxyacteic acid proved to be less stable than peroxide and even in the test solution markedly decreased in concentration over the experimental period. The results suggest that this chemical degradation process is slowed in the presence of perlite and zeolite (Figure 2).

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SpillFix®

The Threat Stops Here.

SOURCE

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