CHLORINE AND VINEGAR 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

OMRI Listed For Organic Use

SpillFix®

Environmentally responsible solutions for a safer workplace

american greenventures

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www.spillfix.com

AIM

This study was done to identify any risks that might eventuate if an absorbent used to treat a spill of a chlorine bleach was to come in contact with an absorbent used to treat a vinegar spill.

BACKGROUND

The concern that motivated the study was that vinegar could lower the pH enough to increase chlorine gas emission from the absorbent containing the bleach.

This scenario could possibly happen if:

1. The same absorbent was used to deal with spills of vinegar and of bleach. This would seem to be a serious misuse of any absorbent. Furthermore, the mixing of the two spills would need to happen within minutes while the liquids were still chemically active.

2. The spent absorbent materials were later thoroughly mixed together. While it is conceivable that one spent absorbent could be placed on top of the other it seems highly unlikely that they would be uniformly mixed together while still chemically active.

DEFINITIONS

Liquid chlorine consists of HOCl (hypochlorous acid), OCl – (hypochlorite anion) and Cl_2 (dissolved chlorine gas) in aqueous solution. This is referred to as the free chlorine component.

Chlorine gas has a distinctive smell and is quite toxic.

pH EFFECT

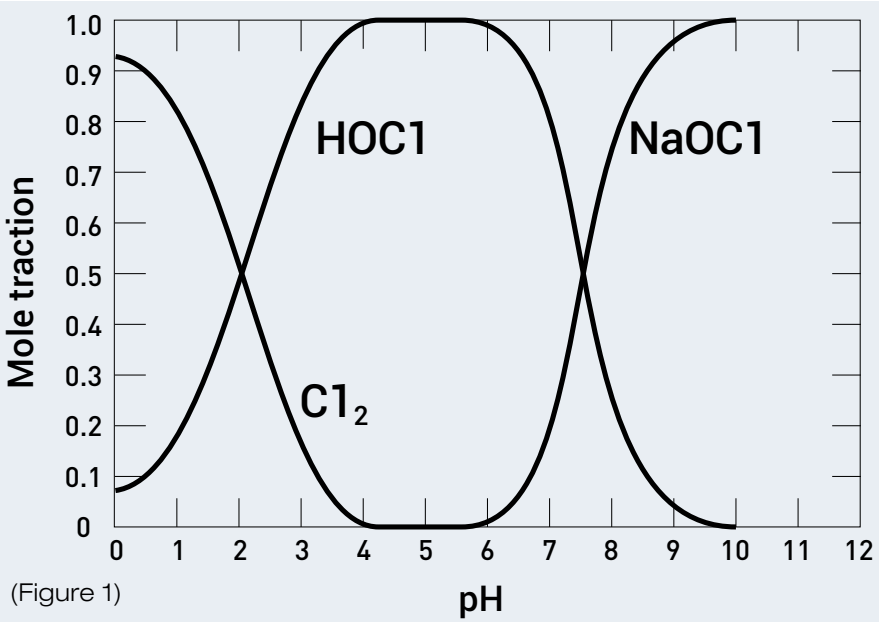
Sodium hypochlorite dissociates in water in the following way:

$$NaOCl + H_20 \Rightarrow HOCl + NaOH$$

Figure 1 (right): Influence of solution pH on the dominant free chlorine species. When the pH pH falls below 2, the main form is Cl_2 which is lost as a gas to the atmosphere.

STABILITY

Sodium hypochlorite solutions are unstable. When open to the air, chlorine evaporates at a high rate from the solution, rapidly reducing the concentration of free chlorine. When heated, sodium hypochlorite disintegrates. Free chlorine also reacts with organic matter forming chloramines.



(Figure 1)

The predominant form of the free chlorine components depends on the pH.

PROCEDURE

This study investigated the worst case scenario where absorbents used on a vinegar spill and on a bleach spill were uniformly mixed together within 10 minutes of use.

Vinegar and liquid bleach sold as household cleaning agents were purchased from a hardware store, plate 1 (left).

The vinegar was a full strength white product. The label did not provide details of the forms of acid or their concentrations.

The liquid bleach contained sodium hypochlorite 38.6g/L and sodium hydroxide 6.9g/L. The sodium hydroxide is possibly added to raise the pH and so stabilize the product.

A 250mL volume of SpillFix absorbent was placed in several receptacles. 100mL of either vinegar or bleach was then added to a shallow depression was made in the center of the absorbent.

The material was then stirred until the liquid had been fully absorbed. Not all of the absorbent was needed to accomplish this, plate 2 (right).

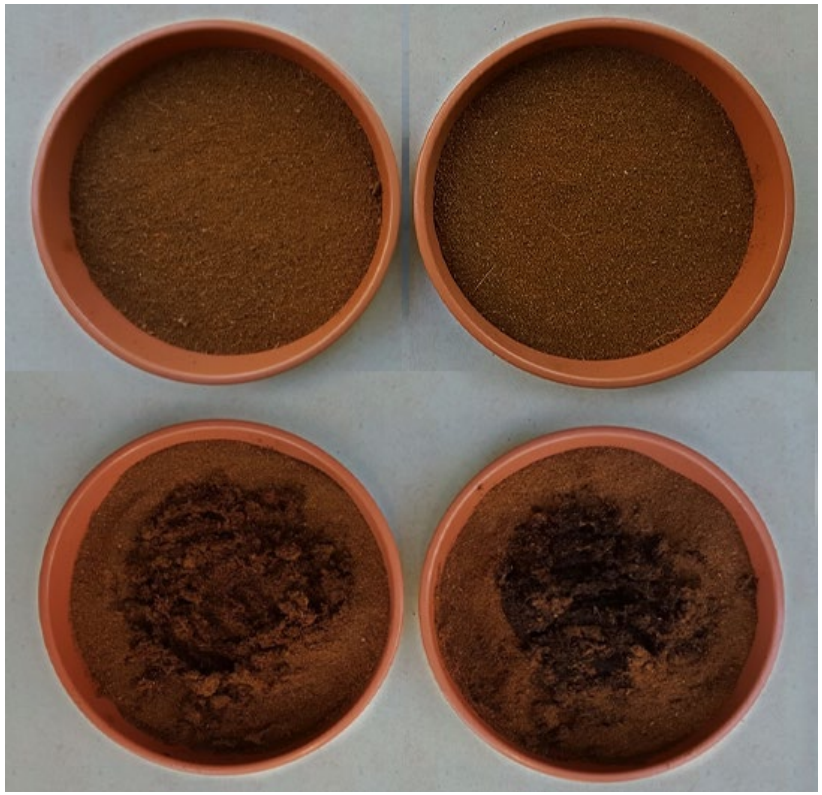


Plate 2: Samples of SpillFix before and 8 minutes after treatment with vinegar (left) and bleach (right).

OBSERVATIONS

The SpillFix that was saturated with vinegar had a slight but inoffensive vinegar smell.

The SpillFix saturated with bleach had a mild chlorine odor that was no stronger than what is experienced at a public swimming pool.

The chlorine smell became almost undetectable 5 to 10 minutes after the bleach had been absorbed.

Adding the bleach to the absorbent raised its temperature and made it a darker color (plate 3). The color change was permanent.

The reaction between the bleach and the absorbent was not violent and was only noticed because of the temperature change. Infrared thermography was used to monitor the temperature of the material.

There was no risk of fire from the reaction because the maximum temperature recorded was only 48°C (118.4°F) and this fell to 37°C (98.6°F) within 17 minutes (plates 4 and 5).

There was no significant change in either the temperature or the color of the vinegar soaked absorbent.

Plate 3: Appearance of the treated material 6 days later.

OBSERVATIONS

Plate 4: Temperature profile after SpillFix was saturated with vinegar (left) or bleach (right). Maximum temperature recorded 48°C (118.4°F).

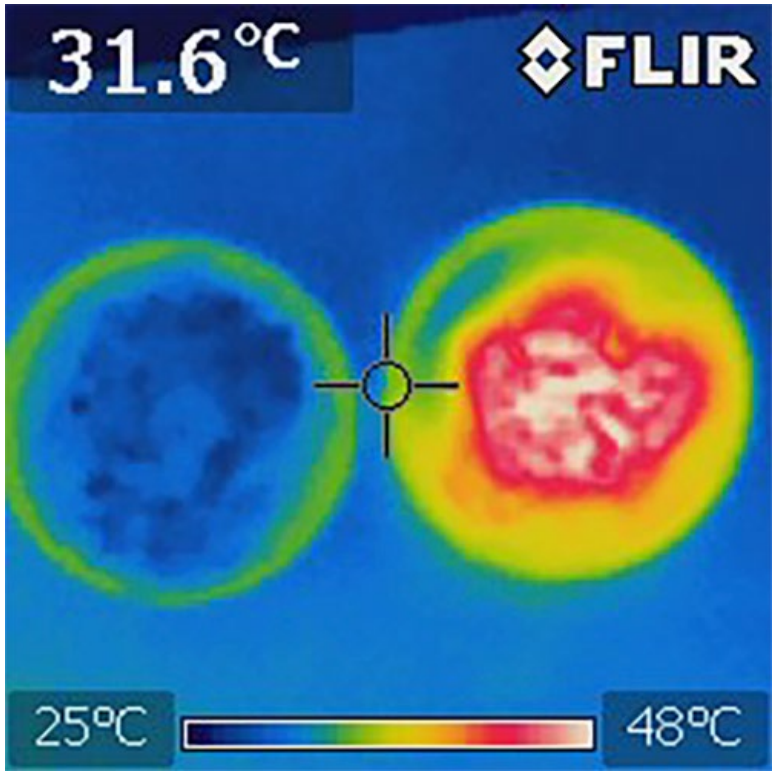
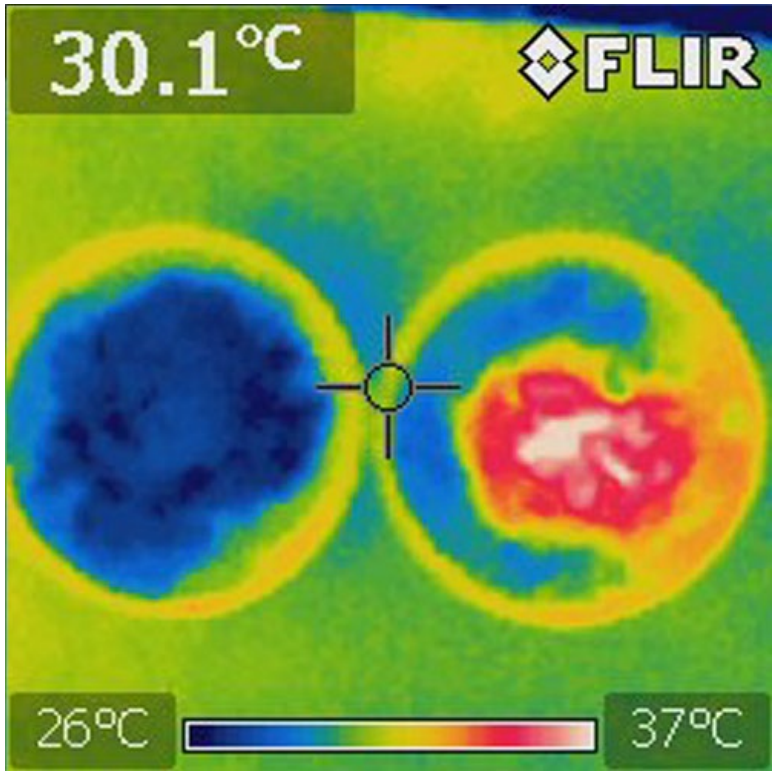


Plate 5: Temperature profile 17 minutes after treatment maximum temperature recorded was 37°C (98.6°F).



pH CHANGES

The pH of SpillFix is around 6 and the material is not highly buffered. This means that a small amount of an acid or an alkali can bring about a relatively large change in pH.

Adding the vinegar dropped the pH by almost 3 points and adding the bleach raised it by almost the same degree (Table 1).

Table: 1 – The materials varied in bulk density

pH of untreated and treated SpillFix absorbent

Material	pH 1:1.5v/v	Comment
Untreated SpillFix	6.07	
SpillFix + Vinegar	3.7	Lowered pH
SpillFix + Bleach	8.86	Raised pH
Vinegar + Bleach	4.96	<pH4 Chlorine Gas

A 1:1v/v mixture of the absorbents had a pH that was still about 1 point lower than the untreated SpillFix. The value was still safely above pH 4 where chlorine gas starts to be produced and well above pH 2 where chlorine gas is the dominant species.

DISCUSSION

The study found that mixing SpillFix used to absorb household bleach with material used to absorb household vinegar is unlikely to significantly increase the risk normally associated with breathing vapor from a bleach spill.

Normal health and safety precautions used with bleach should be sufficient to protect users of the product.

The study has shown that in the unlikely event that the two absorbents were uniformly mixed in a ratio of 1:1v/v, the resulting pH of the combined material would be safely above pH4. This means that any free chlorine present in the absorbent would not be suddenly converted to chlorine gas.

SOURCE

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February 22, 2016

SpillFix®

The Threat Stops Here.

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