

Buckner Environmental Associates, LLC

Bench-Scale Evaluation of CupriDyne Clean for Odor Mitigation

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Introduction and Methods

CupriDyne Clean, an iodine based oxidant, was evaluated for its efficacy in reducing odors from grass clippings at five dilution ratios and using three methods of application. Grass clippings were sealed in a black 32 gallon plastic bag for one week prior to testing to ensure that the material was anaerobic and highly odorous. Composite samples of grass clippings were then taken and placed in individual one gallon plastic bags. Dilution ratios for the odor control product were 10:1, 15:1, 25:1, 35:1, and 50:1. Control samples were evaluated for each dilution factor. The three methods of application included misting, spraying, and mixing with the feedstock to ensure particle contact. Time intervals for evaluating odors are indicated in the enclosed spreadsheet (Table1).

Odor was evaluated using an intensity scale of 0 to 5 and odor character descriptors as described below. The protocol for odor evaluation is based on a similar procedure used by the Massachusetts DEP for evaluating odor at composting facilities.

Protocol for Determining Odor Conditions during Bench Scale Testing

Use a five (5) point odor intensity field reference scale as noted below:

- 0 - Odor not detectable
- 1 - Very Light Odor present in the air which activates the sense of smell but the characteristics may not be distinguishable
- 2 - Light Odor present in the air and is distinguishable and definite, is not necessarily objectionable in short durations but may be objectionable in longer durations
- 3 - Moderate Odor present in the air which easily activates the sense of smell, is very distinct and clearly distinguishable and may tend to be objectionable and/or irritating
- 4 - Strong Odor present in the air which would be objectionable and cause a person to attempt to avoid it completely
- 5 - Very Strong Odor present which is so strong it is overpowering and intolerable for any length of time

Odor Character Descriptors include dirt, earthy, musty, sweet, sour, vinegar, ammonia, tobacco, grassy, rotten grass, butterscotch, maple syrup, musty, rotten fruit, rotten garbage, sour milk, rotten eggs, burnt chocolate, paint, rotten apples, rotten vegetation, manure, and sewage.

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Odor Evaluation

Most odors in the controls were rated as very strong (5) with a few rated as strong (4). Descriptors initially included sour, ammonia, rotten garbage, sour milk, rotten vegetation, manure. Over the course of the testing period, odor intensity in the controls remained strong and descriptors after 18 hours were mostly rotten grass and sour. While there was variability in results between dilution rates and application methods, some trends were observed. All data is shown in Table 1.

Evaluation of odor reduction indicated that the CupriDyne product worked quickly (within 10 minutes) with odors being reduced to very light (1), light (2), to moderate (3), with descriptors such as musty and/or grassy at several dilution ratios and application rates. It appears that, in general, these low odor levels were maintained for at least six hours. Odor levels increased by the next sampling at 18 hours, suggesting that reapplication is needed somewhere between 6 and 18 hours to maintain low odor levels from highly odorous feedstocks, e.g., old fermenting grass clippings.

When looking at the results in terms of dilution, ratios of 10:1, 15:1, and often 25:1 (depending on the application method) appeared to yield and maintain low odor levels for at least 6 hours but not longer than 18 hours. Low odor levels were also observed for dilution rates of 35:1 and 50:1 for certain time periods and methods of application. Results were not as consistent, however, as observed for the lower dilution rates.

In evaluating the methods of application, it appears that a topical spray with complete coverage of the odorous material consistently resulted in low odor levels over time. Misting and mixing the odor control product also resulted in low odor levels much of the time. Since spraying uses less product than mixing, it appears that spraying is the most economical method of application as well. Since there are numerous potential sources of odor at a given composting facility, applications that are better suited to spraying or misting are likely to work well especially when misting is an ongoing process as compared to the one time application during these tests.

Summary and Conclusions

Human response to odor is highly subjective and variable among individuals. Perception of whether or not an odor is offensive depends on many characteristics, such as odor type, concentration, intensity and quality. Although it is preferable to take quantitative measurements to document if an odor control product is working, qualitative evaluation of odor reduction along with odor quality characteristics serves as a valuable tool to demonstrate odor reduction capability and potential.

Although odor reduction appears to be effective for a period between 6 and 18 hours within this bench-scale evaluation, it is important to note that odor mitigation may last longer in a field composting application in which operations are implemented to create aerobic conditions and improve process management associated with potential odor issues.

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As shown in these tests, the qualitative evaluation of odor reduction capabilities of CupriDyne Clean indicate that the product has the potential to substantially mitigate odors that may arise during composting. Follow-up quantitative analysis of odor reduction is needed to verify maximum effective dosages, duration, and types of application under a variety of conditions during the composting process and at other point and area sources.

Although further quantitative testing is recommended, it is clear at this point that the product reduces odors at various dilution rates in a highly odorous and putrescible composting feedstock. In addition, the methods of application tested indicate that the product is compatible with application methods that are commonly available at various types of composting facilities, e.g., windrows, ASP, and in-vessel systems as well as at other organics recovery and waste treatment facilities.

Table 1

Cup/Dyne Clean - Evaluation of Dilution Rates and Application Methods for Odor Reduction

1. Feedstock: Grass clippings (held in a sealed plastic bag for 1 week prior to testing)
2. Odor Character described for controls and all dilution factors at 10 minutes and 30 minutes after application.
3. Odor character for other time intervals up to 6 hours remained similar to the corresponding descriptions for the odor intensity scales reported, and are not repeated
4. See notes below for definitions and explanation of terms.

date	dilution factor	application (emit, spray to saturate; mixed in for particle contact)	Time after application	odor	conc.	odor character ^c	Time after application	odor	conc.	odor character ^c	Time after application	odor	conc.	odor character ^c	Time after application	odor	conc.	odor character ^c	Time after application	odor	conc.	odor character ^c	Time after application	odor	conc.	odor character ^c	dilution factor	application (emit, spray to saturate; mixed in for particle contact)	Time after application	odor	conc.	odor character ^c				
				intensity scale ^a				intensity scale ^a				intensity scale ^a				intensity scale ^a				intensity scale ^a				intensity scale ^a						intensity scale ^a			intensity scale ^a	intensity scale ^a	intensity scale ^a	intensity scale ^a
				(1-5)					(1-5)					(1-5)					(1-5)					(1-5)												
5/30-31/2016	Control	NA	10 min	5	N/A	odor: ammonia, rotten garbage, sour milk, rotten vegetation, manure	30 min	5	N/A	odor: ammonia, rotten garbage, sour milk, rotten vegetation, manure	40 min	5	N/A	See item 3 above for explanation	60 min	5	N/A	See item 3 above for explanation	90 min	5	N/A	See item 3 above for explanation	120 min	5	N/A	See item 3 above for explanation	6 hours	5	N/A	See item 3 above for explanation	Control	NA	18 hours	5	N/A	rotten grass, sour
5/30-31/2016	50 to 1	mist	10 min	3	N/A	moist, grassy	30 min	3	N/A	ammonia, moist, grassy	40 min	2	N/A		60 min	1-2	N/A		90 min	3	N/A		120 min	2	N/A		6 hours	3	N/A		50 to 1	mist	18 hours	4	N/A	rotten grass
5/30-31/2016	50 to 1	spray	10 min	2	N/A	moisty	30 min	2	N/A	moisty	40 min	2	N/A		60 min	1-2	N/A		90 min	2	N/A		120 min	2	N/A		6 hours	2	N/A		50 to 1	spray	18 hours	3	N/A	grass, moisty
5/30-31/2016	50 to 1	mix	10 min	1	N/A	moisty	30 min	1	N/A	moisty	40 min	2	N/A		60 min	1-2	N/A		90 min	2	N/A		120 min	2	N/A		6 hours	2	N/A		50 to 1	mix	18 hours	4	N/A	rotten grass
5/30-31/2016	Control	NA	10 min	5	N/A	odor: ammonia, rotten garbage, sour milk, rotten vegetation, manure	30 min	4	N/A	odor: ammonia, sour milk, rotten vegetation	40 min	4	N/A		60 min	5	N/A		90 min	5	N/A		120 min	5	N/A		6 hours	4	N/A		Control	NA	18 hours	4	N/A	rotten grass, sour
5/30-31/2016	50 to 1	mist	10 min	3	N/A	moist, grassy, ammonia	30 min	2	N/A	moisty	40 min	1-2	N/A		60 min	1-2	N/A		90 min	2	N/A		120 min	2	N/A		6 hours	3	N/A		50 to 1	mist	18 hours	4	N/A	rotten grass, sour
5/30-31/2016	50 to 1	spray	10 min	2	N/A	moisty	30 min	2	N/A	moisty	40 min	1-2	N/A		60 min	1-2	N/A		90 min	2-3	N/A		120 min	2	N/A		6 hours	2	N/A		50 to 1	spray	18 hours	3	N/A	grass, moisty
5/30-31/2016	50 to 1	mix	10 min	3	N/A	moist, grassy	30 min	2	N/A	moisty	40 min	1-2	N/A		60 min	1-2	N/A		90 min	2-3	N/A		120 min	2	N/A		6 hours	2	N/A		50 to 1	mix	18 hours	4	N/A	rotten grass, sour
5/30-31/2016	Control	NA	10 min	5	N/A	odor: ammonia, rotten garbage, sour milk, rotten vegetation, manure	30 min	5	N/A	odor: ammonia, sour milk, rotten vegetation, manure	40 min	5	N/A		60 min	5	N/A		90 min	5	N/A		120 min	5	N/A		6 hours	5	N/A		Control	NA	18 hours	5	N/A	rotten grass, sour
5/30-31/2016	25 to 1	mist	10 min	2	N/A	moisty	30 min	2	N/A	moisty	40 min	2	N/A		60 min	2-3	N/A		90 min	2-3	N/A		120 min	2-3	N/A		6 hours	2	N/A		25 to 1	mist	18 hours	4	N/A	rotten grass, sour
5/30-31/2016	25 to 1	spray	10 min	2	N/A	moisty	30 min	2	N/A	moisty	40 min	2	N/A		60 min	3	N/A		90 min	2-3	N/A		120 min	2	N/A		6 hours	2	N/A		25 to 1	spray	18 hours	3	N/A	grass, moisty
5/30-31/2016	25 to 1	mix	10 min	2-3	N/A	moist, grassy	30 min	3	N/A	moist, grassy	40 min	3	N/A		60 min	2	N/A		90 min	2-3	N/A		120 min	2	N/A		6 hours	2	N/A		25 to 1	mix	18 hours	4	N/A	rotten grass, sour
5/30-31/2016	Control	NA	10 min	5	N/A	odor: ammonia, rotten garbage, sour milk, rotten vegetation	30 min	5	N/A	odor: ammonia, sour milk, rotten vegetation	40 min	5	N/A		60 min	5	N/A		90 min	5	N/A		120 min	5	N/A		6 hours	4	N/A		Control	NA	18 hours	5	N/A	rotten grass, ammonia, sour
5/30-31/2016	50 to 1	mist	10 min	3-4	N/A	moist, rotten grass, sour	30 min	3	N/A	moist, grassy, ammonia	40 min	3	N/A		60 min	3	N/A		90 min	3	N/A		120 min	3	N/A		6 hours	2	N/A		50 to 1	mist	18 hours	4	N/A	rotten grass, sour
5/30-31/2016	50 to 1	spray	10 min	2	N/A	moisty	30 min	2-3	N/A	moist, grassy	40 min	2-3	N/A		60 min	2-3	N/A		90 min	2-3	N/A		120 min	2-3	N/A		6 hours	2-3	N/A		50 to 1	spray	18 hours	4	N/A	rotten grass, sour
5/30-31/2016	50 to 1	mix	10 min	2	N/A	moisty	30 min	2-3	N/A	moist, grassy	40 min	2-3	N/A		60 min	2	N/A		90 min	2-3	N/A		120 min	2	N/A		6 hours	2	N/A		50 to 1	mix	18 hours	4	N/A	rotten grass, sour
5/30-31/2016	Control	NA	10 min	5	N/A	odor: ammonia, rotten garbage, sour milk, rotten vegetation	30 min	5	N/A	odor: ammonia, rotten garbage, sour milk, rotten vegetation	40 min	5	N/A		60 min	5	N/A		90 min	5	N/A		120 min	5	N/A		6 hours	5	N/A		Control	NA	18 hours	4	N/A	rotten grass, sour
5/30-31/2016	50 to 1	mist	10 min	4	N/A	odor: grass, rotten vegetation	30 min	4	N/A	odor: ammonia, rotten vegetation	40 min	3	N/A		60 min	3	N/A		90 min	3	N/A		120 min	3	N/A		6 hours	3	N/A		50 to 1	mist	18 hours	4	N/A	rotten grass, sour
5/30-31/2016	50 to 1	spray	10 min	3	N/A	moist, grassy, ammonia	30 min	3	N/A	moist, grassy	40 min	2-3	N/A		60 min	2-3	N/A		90 min	2-3	N/A		120 min	3	N/A		6 hours	3	N/A		50 to 1	spray	18 hours	6	N/A	rotten grass, sour
5/30-31/2016	50 to 1	mix	10 min	2-3	N/A	moist, grassy	30 min	3	N/A	moist, grassy	40 min	2-3	N/A		60 min	2-3	N/A		90 min	2-3	N/A		120 min	3	N/A		6 hours	3	N/A		50 to 1	mix	18 hours	4	N/A	rotten grass, sour

a) Protocol for Determining Odor Conditions During bench scale testing

Use a five (5) point odor intensity field reference scale as noted below:

- 0 - Odor not detectable.
- 1 - Very Light - Odor present in the air which activates the sense of smell but the characteristics may not be distinguishable.
- 2 - Light - Odor present in the air and is distinguishable and definite but not necessarily objectionable in short durations but may be objectionable in longer durations.
- 3 - Moderate - Odor present in the air which easily activates the sense of smell, is very distinct and clearly distinguishable and may tend to be objectionable and/or irritating.
- 4 - Strong - Odor present in the air which would be objectionable and cause a person to attempt to avoid it completely.
- 5 - Very Strong - Odor present which is so strong it is overpowering and intolerable for any length of time.

b) ID/T = dilutions to threshold as measured by ASTM or EN methods, or field olfactometer as indicated

c) odor character descriptors, e.g., dirt, earthy, musty, sweet, sour, vinegar, ammonia, tobacco, grassy, rotten grass, butterscotch, maple syrup, moisty, rotten fruit, rotten garbage, sour milk, rotten eggs, burnt chocolate, paint, rotten apples, rotten vegetation, manure, sewage