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Evaluation of Anti-fouling Paints

Background

Repogle flumes are often used as a flow measurement device in irrigation canals. Algae and other growth on the flumes can effect the accuracy of measurements. Research was conducted to find a product that when applied to the flume would prevent the buildup. It was found that a type of paint known as anti-fouling paint could potentially work. Anti-fouling paint is made for boat bottoms to prevent the build-up of algae and other marine life. Most anti-fouling paints are designed to be applied to boat bottoms, which are mainly composed of fiberglass, wood, steel or iron. A search was initiated to find anti-fouling paints, which could be applied to a concrete flume structure.

Types of Paint

According to Interlux Paint Company (http://www.yachtpaint.com) there are five basic types of anti-fouling paints.

1. **Hard Anti-foulings:** This is the type of paint used in this experiment. The technical term for this paint is “contact leaching”. The advantage to this type of paint is its resistance to abrasion and rubbing. A disadvantage to this type of paint is having to remove the paint and re-coat after the biocides wear out.

2. **Copolymer Anti-foulings:** This type of paint is partially soluble. This means that as the water passes over the paint the coat wears down. The action of the water moving over the paint reduces the thickness of the paint at a controlled rate. The advantage to this paint is that there is always a fresh surface of biocides. Another advantage of this type of paint is that because it wears away there is no build-up of paint, which must later be removed. The disadvantage to this paint is that it does not last as long as the hard anti-foulings.
3. **Ablative Anti-foulings:** This type of paint works in the same way as the copolymer paint with one exception. According to Interlux their ablative paint loses its effectiveness after being dry for 30 days. Trinidad and E-Paint Company also manufacture ablative paints and have stated that having a dry condition for up to 30 days should not effect their paint. They do recommend that if the paint is dry for 2-3 months a fresh cost be applied.
4. **Teflon Anti-foulings:** This type of paint adds the nonstick product Teflon to the paint. This is mainly used to reduce the friction on boat bottoms and does not have an application for flumes.
5. **Soft Anti-foulings:** Soft anti-foulings are cheaper and easier to clean than hard anti-foulings. The disadvantage of this type of paint is that it must be under water within 48 hours of application to maintain its effectiveness. This can be difficult in canals at times.

Capsaicin

Another factor explored after testing began was the use of **Capsaicin** as an additive to the anti-fouling paints. Capsaicin is the “hot” ingredient found in chilies and Tabasco sauce. Capsaicin is registered by the EPA as a bird, animal and insect repellent. Specifically it is used to repel birds, voles, deer, rabbits, squirrels, insects and attacking dogs (according to http://www.epa.com). In 1991, it was reclassified by the EPA as a biochemical pesticide. The EPA does not foresee the potential for significant environmental risks with the use of capsaicin. However, high levels of capsaicin can be toxic. When added to the anti-fouling paints capsaicin may increase the paint’s ability to prevent growth. Currently some boat owners have been known to add a bottle of

Tabasco sauce to one gallon of anti-fouling paint before application. No formal testing has been done on the effectiveness of capsaicin in this application.

Paints Used

Three anti-fouling paints were selected through research via the Internet and telephone conversations with the manufacturers. The products selected for testing were:

- Trinidad Antifouling by Pettit Paint Company
- Ultra-Kote by Interlux Paint Company
- No-Foul by E-Paint Company

Contact and cost information for the three paints can be found in table 1 below.

Table 1. Contact information for the paints used.

Contact and Cost Information

Company	Paint Product Used	Phone Number	Internet Address	Cost per gallon
E-Paint Company	No-Foul	(800) 258-5998	http://www.epaint.net	$120
Interlux Paint Company	Ultra-Kote	(800) 468-7589	http://www.yachtpaint.com	$110
Pettit Paint Company	Trinidad	(800) 221-4466	http://www.petitprod.com	$170

*** costs do not include tax or shipping**

The No-Foul paint was ordered directly from the manufacturer. The other two paints were ordered from a boating store located in Santa Barbara, California (The Chandlery, 805-965-4538).

The Ultra-Kote and Trinidad paints were chosen because of their high percentages of cuprous oxide (up to 75%), which is the effective ingredient in the paint. The No-Foul product is unique in that it does not contain copper and is therefore more environmentally friendly. The products were also chosen for their ability to be applied effectively to concrete. Many anti-fouling paint products are not designed to be applied to concrete.

The paint products chosen are known as Hard Anti-foulings which work through what is known as contact leaching. The paint dries to a porous film that is packed with

biocides. The biocides leach out of the paint on contact with water, which prevents growth. The amount of biocide decreases over time until there is not enough biocide left to prevent growth. Once the paint is out of biocides the paint must be re-applied. The paints are designed to last a season (approximately 6 months to 1 year) and have been reported to last as long as 6 years. The manufacturers would not speculate on the length of the paint's effectiveness for this application.

Application Procedures

The manufacturers of the above products were consulted for details on application. The manufacturers of Trinidad and Ultra-Kote suggested that the concrete be acid etched before applying the paint. Acid etching involves applying Muriatic Acid (Hydrochloric Acid solution) to the concrete. Safety equipment should be worn at all times when handling the acid. For a list of safety equipment see the following section. The acid is mixed with water to a concentration such that when applied to the concrete the solution bubbles. Be sure to add acid to water, not water to acid. The solution is then left on the concrete for five minutes and rinsed. The concrete should be allowed to dry before applying the paint.

The manufacturer of No-Foul stated that the concrete did not need to be acid etched. Instead they suggested that the concrete be pressure washed before applying the paint. The concrete may be damp but not saturated when applying this paint.

For testing purposes a portion of concrete on the Cal Poly model canal located at the Water Delivery Facility was divided into two sections. Both sections were first power washed and initially cleaned with a wire brush. One section was then additionally acid etched. All three paints were applied to both sections of concrete. Each section was also split into two subsections. One of the subsections was dried using a propane torch while the other section was allowed to stay damp. This was done to simulate both damp and completely dry concrete. One-foot wide sections of each paint were applied to each section of concrete.

Safety Procedures

Cuprous oxide, the active ingredient in the paints can irritate the lungs, nose, throat and skin if contacted or inhaled. In order to prevent this certain safety procedures should be followed when applying the paint. Another safety concern is the application of the Muriatic Acid during acid etching of the concrete. The following safety equipment should be worn at all times when exposed to the paint or the Muriatic Acid:

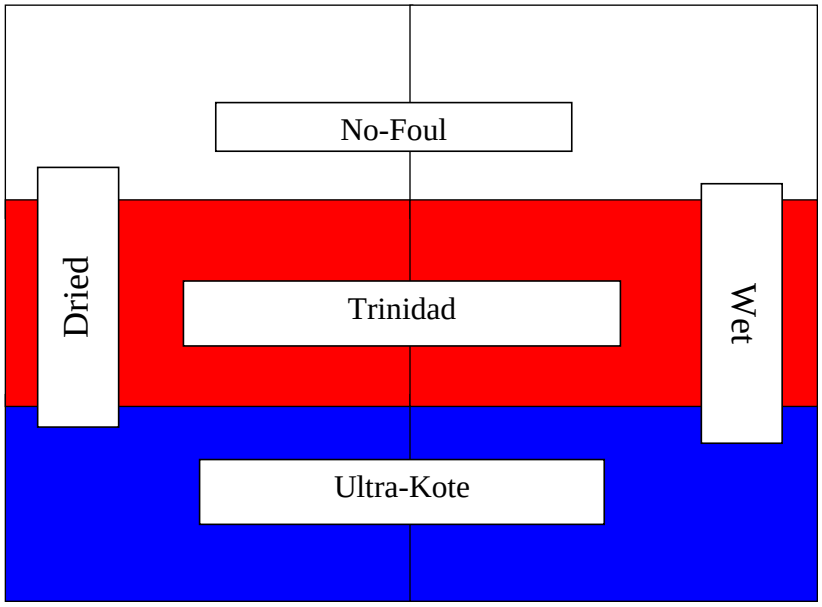
- Safety goggles to protect the eye area
- Gloves to prevent contact with the skin
- Breathing mask to protect the nose, throat and lungs

This equipment can be purchased at any local hardware or construction store.

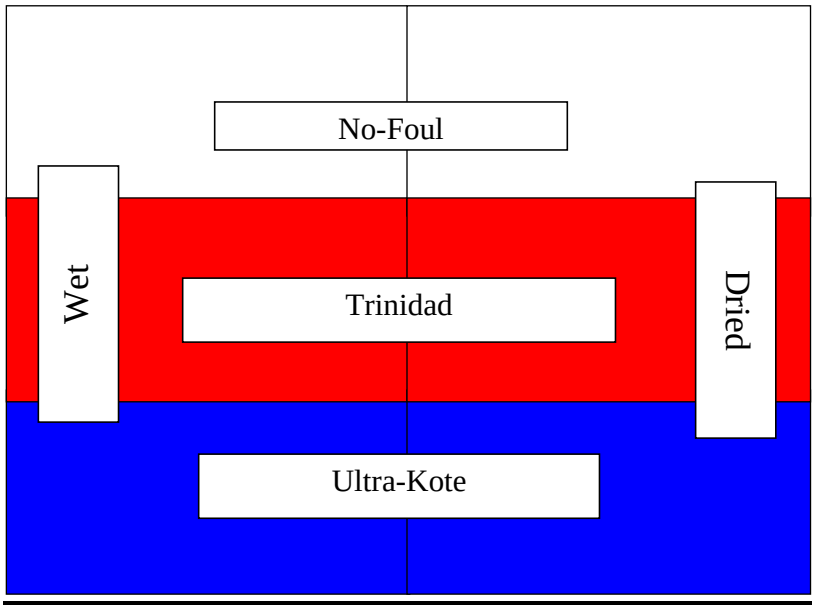
Layout

A schematic of the paint layout on the canal can be found on the following page.

Schematic of Quick Paint Trials at the ITRC



Section 1: Wire Brushed only



Section 2: Acid etched

Testing Procedure

Testing began on June 26, 2000. The paints were kept under water for the duration of the testing period with one exception. The canal was dry from September 5, 2000 to September 15, 2000. Water was reapplied from September 16, 2000 until the time of this report (October 23, 2000).

Observations:

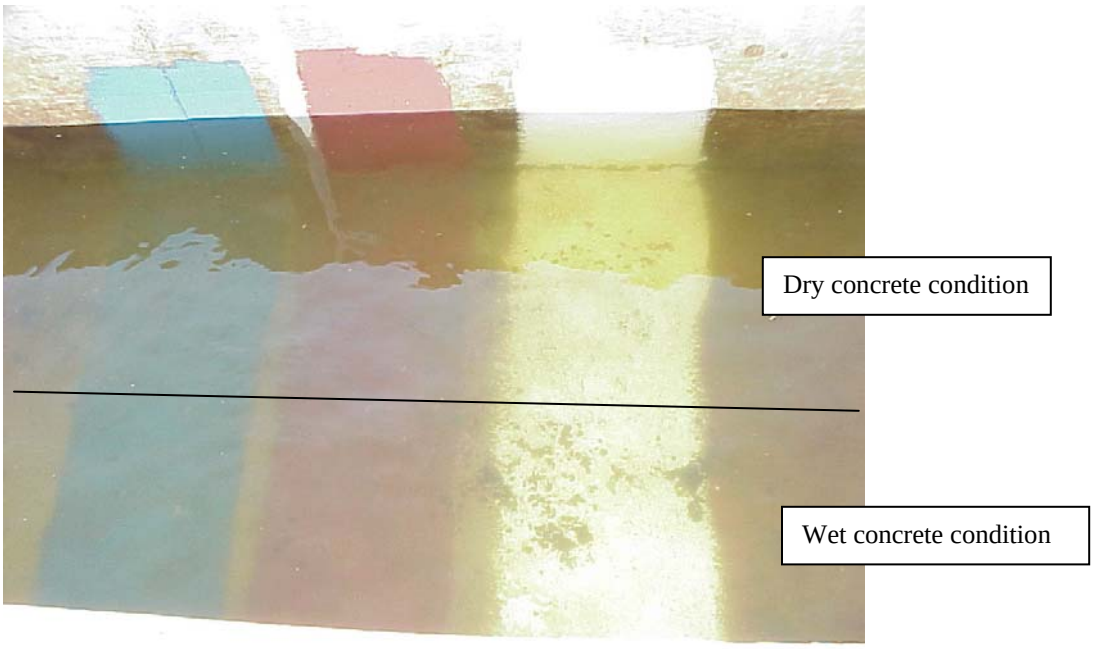
The paints were observed weekly from the start of the testing. The No-Foul paint began to peel approximately one month after the start of the test. The other two paints did not exhibit any visible peeling. Pictures of the two sections of paint were taken after two months of testing on September 29, 2000. Photos were taken before and after the sections were cleaned with a broom. The photos can be found on the following pages.

Results

The results as of October 23, 2000 can be found in table 2 below.

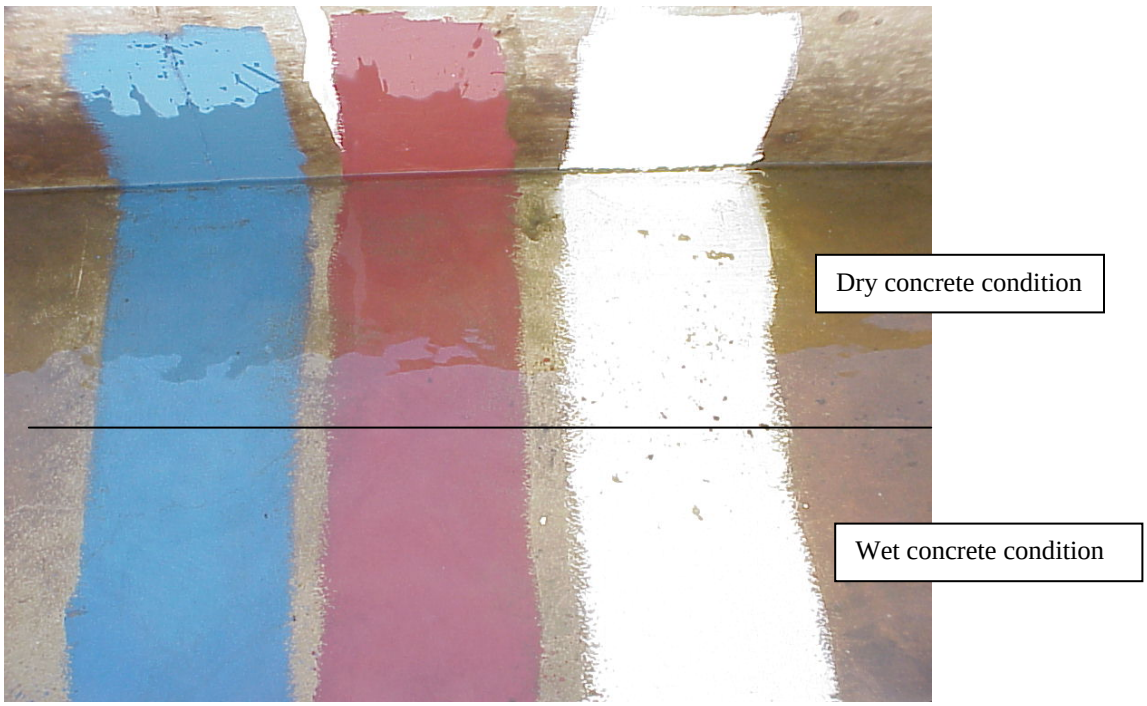
Table 2. Results of testing as of October 23, 2000

Product	Growth of algae or slime?	Peeling?	Acid-etched vs. Non-acid etched	Wet vs. Dry concrete condition
Trinidad	No	No	No difference	No difference
Ultr-Kote	No	No	No difference	No difference
No-Foul	No	Yes	No difference	No difference



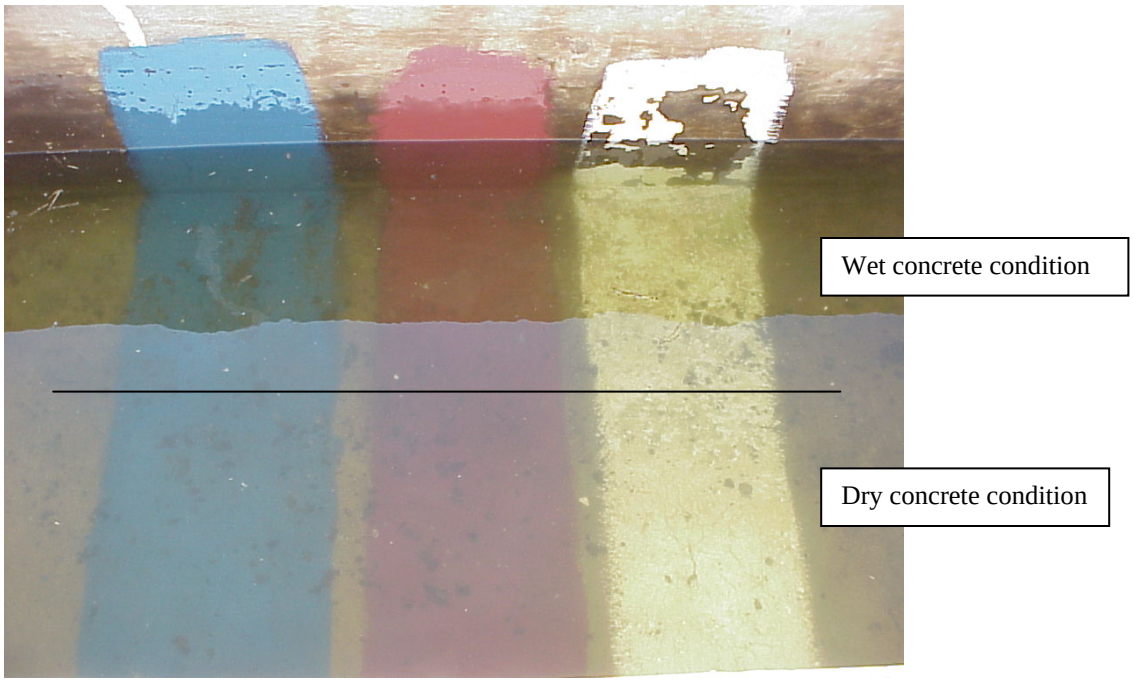
From left to right: Ultra-Kote, Trinidad, No-Foul

Figure 1. Section 1 no acid etching before cleaning



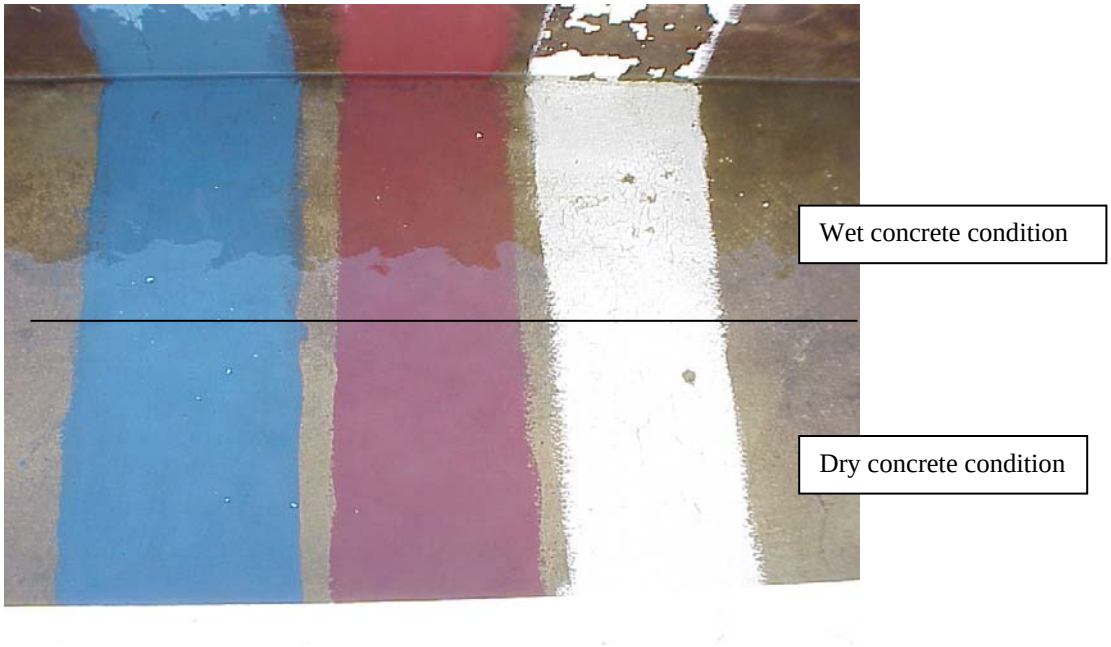
From left to right: Ultra-Kote, Trinidad, No-Foul

Figure 2. Section 1 no acid etching after cleaning



From left to right: Ultra-Kote, Trinidad, No-Foul

Figure 3. Section 2 with acid etching before cleaning



From left to right: Ultra-Kote, Trinidad, No-Foul

Figure 4. Section 2 with acid etching after cleaning

Conclusions

As of October 23, 2000:

- Acid etching did not appear to be a factor in performance.
- The dampness of the concrete does not appear to make a difference in performance.
- The high copper content anti-fouling paints (Trinidad and Ultra-Kote) had the best performance over the duration of the test. Neither paint showed signs of peeling.
- The water based non-copper paint (No-Foul) exhibited significant peeling over the three months of the test.

At this time the anti-fouling paints appear to prevent the build-up of slime and algae on concrete which can affect the performance of flumes. Long term testing will better determine differences between the paint products and application procedures. The copolymer and ablative paints were not considered in this experiment. However, from research the copolymer and ablative paints appear to be a better solution than the hard anti-fouling paints due to the lack of paint build-up. Further experiments should be run with this type of paint. Also the use of Capsaicin as an additive should be explored. From the research conducted there appear to be several key points to consider when selecting an anti-fouling paint.

Key points to consider are:

- Can the product be applied to concrete?
- What are the application and safety procedures?
- Is the paint EPA approved?
- What is the length of time before it must be reapplied?
- What is the percentage of copper in the paint? Generally more is better.