

ERDC/EL TR-15-9

Environmental Laboratory



**US Army Corps
of Engineers®**
Engineer Research and
Development Center

ERDC
INNOVATIVE SOLUTIONS
for a safer, better world

Aquatic Nuisance Species Program

Zebra Mussel Chemical Control Guide

Version 2.0

LeeAnn M. Glomski

July 2015

Aromatic Hydrocarbons

These compounds are ring-structure organics with film-forming and surfactant activity and include formulations that have been used as biocides in industrial water-handling systems for many years.

MEXEL® 432/0

This patented emulsion of alkylamines uses surface-active properties to inhibit sources of water circuit fouling in fresh and salt water, including macrofouling from mollusks, crustaceans, barnacles, and hydroids. Mexel® 432/0 adsorbs to all exposed surfaces of any material type to form a protective film on internal components that remain in place until it

degrades. The aliphatic nature of the amine surfactant film also protects surfaces from corrosion (including MIC and crevice), and acts as a scale and mud dispersant (Giamberini et al. 1994; Armon et al. 2008; Lopez-Galindo et al. 2010).

Chemical Name and Formulations

This product has the following characteristics:

- Chemical name: 1-(Alkyl*amino)-3-aminopropane
*as in fatty acids of coconut oil
- Formulation: Mexel® 432/o
 - 1.7 percent active ingredient
 - Liquid
- USEPA Registration No. 84034-1
- U.S. Distributor: Mexel USA, LLC
1655 N. Fort Myer Dr. #350
Arlington, VA 22209
703-349-3347

Mode of Action

This hydrocarbon compound is a mixture of aliphatic hydrocarbons, with alcohol and amine functionality, in an aqueous emulsion. The aliphatic amines act as surfactants, or “filming amines,” and adhere to wetted metal, plastic, concrete, and glass surfaces to form a protective film. The product inhibits the definitive settlement of mussels by retarding byssal thread formation (Giamberini et al. 1995), limiting adherence to surfaces, and gradually killing zebra mussels already in place by damaging gill surface membranes (Czembor et al. 1997), and dispersing mussels. Thus, it prevents new infestations and gradually disperses existing infestations. It is most effective when used to prevent infestations in a previously cleaned system.

Application Strategies

Mexel® 432/o is used to control mollusks, including zebra mussels, in non-potable industrial water systems (Mexel USA, LLC 2014a). It may be applied to maintain clean systems or to treat systems that are already

fouled. For best results, the system should first be cleaned of adult zebra mussels and then treated.

Treatment is usually on an intermittent basis or as needed to maintain control. Intermittent injection of lower concentrations has been shown to have the potential for reducing molluscicide quantities while maintaining effectiveness (Giamberini et al. 1994). Automated injection is possible at a variety of locations in the water system.

Mexel® 432/0 can be employed in recirculating water systems as well as in open, once-through cooling systems. It is also effective as an acute toxicant for systems that do not have continuous water flow (i.e., fire protection systems, standby facilities) and when discharge is treated (Renaud et al. 2010).

Timing of Application

Initial application early in the season prior to veliger settlement, with continuation of daily dosing throughout the growing season.

Application Rates and Techniques

Dosage is a function of the volume of water in the system. For once-through systems, volume equals the total flow over the 30-minute daily treatment period. In recirculating systems, dosage is calculated on the total water volume in the system.

A standard treatment is 4 to 5 ppm for 20 to 30 minutes per day to achieve a residual level in the water of 2.5 ppm. Monitor the presence of Mexel® 432/0 with colorimetric tests of grab samples. Less frequent dosing and lower residual levels may be possible in certain situations.

Maximum Water Concentrations

Maximum potential concentration in discharged water is 2.5 ppm. Actual levels in discharges are typically much lower due to a number of factors, including immediate demand due to film adhering to surfaces and materials in the water (i.e., suspended solids), water circuit configuration, and other factors.

Use Restrictions

This product is toxic to fish, oysters, shrimp, and aquatic invertebrates.

Do not discharge into lakes, ponds, streams, estuaries, oceans, or other surface waters unless in accordance with a NPDES permit. For guidance, contact your state water board or a regional office of the USEPA.

Do not contaminate water, food, or feed by storage or disposal.

Timing of Results

Treatment shows effects within a few weeks, but continued treatment is required. Monitor treatment efficacy with visual inspections, biofilm coupons, corrosion coupons, etc., at appropriate points in the system.

Toxicological Data

Signal Word: Danger

Note: Standard testing has organisms continuously exposed for long periods of time; however, Mexel® 432/0 is only dosed for 30 minutes per day. This intermittent dosing at sublethal concentrations means that only organisms that remain within the treated system are at risk. Tables 13 and 14 summarize the aquatic toxicology for Mexel® 432/0 for static and acute tests, respectively.

Table 13. Toxicity of Mexel® 432/0 under continuous (static) exposures¹ to aquatic species.

Organism	Test	Result
Rainbow Trout (<i>Oncorhynchus mykiss</i>)	96 hr LC ₅₀	0.73 mg L ⁻¹
Water Flea (<i>Daphnia magna</i>)	48 hr LC ₅₀	0.55 mg L ⁻¹
Fathead Minnow (<i>Pimephales promelas</i>)	96 hr LC ₅₀	0.36 mg L ⁻¹

¹ From Ghillebaert 2012

Table 14. Toxicity of Mexel® 432/0 under short daily exposures^{1,2} to aquatic species.

Organism	Daily Exposure	LC ₅₀ Result
Water Flea (<i>Daphnia magna</i>)	5 min	26.9 mg L ⁻¹
	20 min	6.3 mg L ⁻¹
	80 min	3.0 mg L ⁻¹
Fathead Minnow (<i>Pimephales promelas</i>)	5 min	13.1 mg L ⁻¹
	20 min	6.2 mg L ⁻¹
	80 min	2.2 mg L ⁻¹

¹ From Ghillebaert 2012, ² 96 hr observation period

Precautions

- Corrosive.
- Can cause severe eye irritation.
- Harmful if swallowed, inhaled, or absorbed through skin.
- Wash thoroughly after handling.

Adjuvant/Detoxicant/Deactivant Use

No detoxification is required.

Antidote Information

The following information is from the MSDS for Mexel® 432/0 (Mexel 2014b):

- **Eyes:** Immediately move individual away from exposure and into fresh air. Gently flush eyes with water for at least 15 minutes while holding eyelids apart. Seek immediate medical attention.
- **Skin or clothing:** Remove contaminated clothing. Wash exposed area with soap and water. Flush skin with water for at least 15 minutes. If symptoms persist, seek medical attention. Wash clothing before reuse.
- **Ingestion:** Seek medical attention. Do not give anything by mouth if individual is drowsy or unconscious. Place individual on left side with head down. Do not induce vomiting. Contact a physician, medical facility, or poison control center. If possible, do not leave individual unattended.
- **Inhalation:** Move individual away from exposure and into fresh air. If symptoms persist, seek medical attention. If breathing is difficult, administer oxygen.
- **Emergencies:** 1-800-424-9300

References

- Armon, T., D. Barkauskas, J. J. Cohen, E. C. Mallen. 2008. Mexel efficiency study. HOH Report. <http://pbadupws.nrc.gov/docs/ML0913/ML091340525.pdf>.
- Czemobr, N., L. Giamberini, and J. C. Pihan. 1997. Effects of MEXEL 432 on pumping and valve activities of zebra mussel: used of a new experimental evaluation system. *Proceedings of the Seventh International Zebra Mussel Conference, New Orleans, LA, January 28-31, 1997*.
- Ghillebaert, F. 2012. Untitled presentation summarizing environmental characteristics of Mexel products. Prepared for Mexel Industries SAS, Verberie, France.
- Giamberini, L., N. Czembor, and J. C. Pihan. 1995. Inhibitory effects of an organic molluscicide on byssal thread development in zebra mussels. *J. Invertebr. Pathol.* 66:205-206.
- Giamberini, L., N. Czembor, and J. C. Pihan. 1994. Effects of MEXEL 432 on the settling, detachment and mortality of adult zebra mussels. *Proceedings of the Fourth International Zebra Mussel Conference, Madison, WI, March 7-10, 1994*.
- Lopez-Galindo, C., J. F. Casanueva, and E. Nebot. 2010. Efficacy of different antifouling treatments for seawater cooling systems. *Biofouling* 26(8):923-930.
- Mexel USA, LLC. 2014a. Mexel® 432/o label. Arlington, VA. 1 pg.
- Mexel USA, LLC. 2014b. Mexel® 432/o Material Safety Data Sheet. Arlington, VA. 10 pp.
- Renaud, C., C. de Grandmaison, and F. Ghillebaert. 2010. Mexel® 432: Environmentally friendly protection and treatment of cooling water circuit. In: POWER-GEN Middle East. Qatar. 16 pp.