



# Irrigation Water Chemicals

U.S. ARMY CORPS OF ENGINEERS

Building Strong®

**ANS Control:** Irrigation Water Chemicals - Acrolein and Xylene

**Targeted Species:** Acrolein and xylene are currently registered for use to control nuisance algae and submersed and floating aquatic plants in irrigation canals. Specific ANS of Concern – CAWS<sup>1</sup> that can be controlled by acrolein and xylene include all of the algae species (*Bangia atropurpurea*, *Cyclotella cryptica*, *C. pseudostelligera*, *Stephanodiscus binderanus*, and *Enteromorpha flexuosa*), water chestnut (*Trapa natans*), and dotted duckweed (*Landoltia (Spirodela) punctata*).



Source: Alligare LLC<sup>2</sup>

**Aquatic plants and algae can be problematic in irrigation conveyance systems and can be controlled with proper application of acrolein or xylene.**

**Selectivity:** Acrolein and xylene are non-selective toxicants and will kill most species of algae and submersed and floating aquatic plants. Acrolein and xylene will not control emergent aquatic vegetation (Senseman 2007). Both acrolein and xylene are toxic to fish and other aquatic organisms at use rates that control aquatic plants and algae (Baker Petrolite Corporation 2008; Ross & Lembi 1985; USEPA 2005; USEPA 2008).

**Developer/Manufacturer/Researcher:** Acrolein as the formulation Magnacide® H<sup>2</sup> is manufactured by Baker Petrolite Corporation, Sugar Land, Texas, and exclusively distributed by Alligare LLC, Opelika, Alabama. Xylene as the formulation Aquatic Weed Killer® is manufactured and distributed by Thatcher Company, Salt Lake City, Utah.

**Pesticide Registration/Application:** Pesticides, including irrigation water chemicals, must be applied in accordance with the United States Environmental Protection Agency (USEPA)-approved product label guidelines. Users must read and follow the pesticide product label prior to each application. The registration status, trade name, and availability of pesticides are subject to change. The listing of a pesticide in this fact sheet or Appendix B does not represent an endorsement by the USACE or USEPA regarding its use for a particular purpose.

**Brief Description:** Both acrolein and xylene are active ingredients registered by the USEPA for control of unwanted aquatic vegetation in irrigation conveyance systems, primarily in western states. Acrolein is designated as a “restricted use pesticide” by the USEPA; therefore, it can be purchased and used only by trained and certified applicators to avoid possible adverse health or environmental effects

<sup>1</sup> For a complete list of the 39 specific ANS of Concern – CAWS, please see Table 1 of the main report.

<sup>2</sup> Manufacturers and products mentioned are examples only. Nothing contained herein constitutes an endorsement of a non-Federal entity, event, product, service, or enterprise by the U.S. Army Corps of Engineers or its employees.

(USEPA 2008; Baker Petrolite Corporation 2008). The application of xylene as the formulation Aquatic Weed Killer® is also limited and can be used only for control of submersed weeds in irrigation and drainage canals managed by the Bureau of Reclamation and cooperating water user organizations in several western states (AZ, CA, CO, ID, KS, MT, NE, NV, NM, ND, OR, SD, UT, WA, and WY), provided appropriate state registrations are also in place (USEPA 2005; USEPA 2011; Thatcher Company 2011).

*Acrolein* – Acrolein (acrylaldehyde or prop-2-enal) is a general cell toxicant that destroys enzymes and disrupts plant metabolism (Senseman 2007). Acrolein is readily absorbed by aquatic plants and algae, but poorly by terrestrial vegetation. Aquatic weeds become flaccid within a few hours of exposure, followed by gradual chlorosis (yellowing) and tissue disintegration (Senseman 2007). Acrolein is applied by directly injecting a liquid formulation into the water from pressurized containers; proper application can eliminate plants up to 25 miles downstream (Ross & Lembi 1985). Acrolein is not persistent in aquatic environments; primary mechanisms of degradation are volatilization and hydrolysis (Senseman 2007; Sytsma & Parker 1999).

*Xylene* – Xylene (1,2, 1,3, and 1,4-dimethyl benzene) is an aromatic hydrocarbon formulated as a liquid concentrate and applied with an emulsifier by directly metering or injecting the product below the water surface; submersed vegetation can be controlled for 3 to 6 miles downstream (USEPA 2005; Ross & Lembi 1985). The mechanism of action for xylene in plant cells is unknown. Xylene persistence in water is low; the predominant degradation process is volatilization (USEPA 2005; Sytsma & Parker 1999).

**Prior Applications:** Acrolein and xylene are currently used to control problem submersed and floating plants and algae in irrigation and drainage canals. Terrestrial and shoreline or emergent vegetation will not be affected. Both compounds are non-selective and will kill all vegetation in waters exposed to treatment. Similar to other aquatic herbicides, acrolein and xylene are not used as a “preventative” control measure and cannot be used as a permanent chemical barrier. Neither product is persistent in aquatic sediments and neither will eliminate tubers, seeds, or other plant propagules that reside in sediments.

**General Effectiveness:** When properly applied and in accordance with product label directions, both acrolein and xylene are effective for eliminating submersed and floating aquatic plants and algae from irrigation conveyance systems within a matter of hours. Both compounds are toxic to fish and other aquatic organisms.

The efficacy of acrolein can be impacted under certain environmental conditions. Sytsma and Parker (1999) reported that the toxicity of acrolein to plants is temperature dependent; the concentration required at 60 °F is double that required at 80 °F.

**Operating Constraints:** Constraints for using acrolein and xylene in aquatic environments are defined on the manufacturer product label and may include: restrictions on water use after chemical application; when, where, and how the product can be applied; frequency and maximum rate of application; conditions that can reduce product efficacy; and potential impacts to sensitive, non-target species. Acrolein and xylene are toxic to fish and other aquatic organisms and can be considered

general biocides; sensitivity is dependent on dose and exposure (Sytsma & Parker 1999; Baker Petrolite Corporation 2008; Thatcher Company 2011). Acrolein cannot be used in waters that flow into potential sources of drinking water (Baker Petrolite Corporation 2008).

**Cost Considerations:** Cost will vary with product choice, rate of application, and the size of the treatment area.

**Implementation:** Implementation costs would involve the development of a management plan, purchase and application of the chemical. Planning and design activities in this phase may include research and development of this Control, modeling, site selection, site-specific regulatory approval, plans and specifications, and real estate acquisition. Design will also include analysis of this Control's impact to existing waterway uses including, but not limited to, flood risk management, natural resources, navigation, recreation, water users and dischargers, and required mitigation measures.

**Operations and Maintenance:** Operations and maintenance costs would include monitoring effectiveness of chemical treatment and reapplication when aquatic nuisance species begin to reappear.

**Mitigation:** Design and cost for mitigation measures required to address impacts as a result of implementation of this Control cannot be determined at this time. Mitigation factors will be based on site-specific and project-specific requirements that will be addressed in subsequent, more detailed, evaluations.

## Citations:

- Baker Petrolite Corporation. 2008. Magnacide® H Herbicide Product Label. EPA Reg. No. 10707-9. [http://www.alligarellc.com/Products/PDFs/Magnacide\\_LABEL.pdf](http://www.alligarellc.com/Products/PDFs/Magnacide_LABEL.pdf); [http://www.epa.gov/pesticides/chem\\_search/ppls/010707-00009-20110720.pdf](http://www.epa.gov/pesticides/chem_search/ppls/010707-00009-20110720.pdf)
- Ross, M.A. & C.A. Lembi. 1985. Chapter 13, "Aquatic Weed Control." Pp. 274-305 in *Applied Weed Science*. Macmillan Publishing Company, New York, NY. 340 pp
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[http://www.epa.gov/pesticides/chem\\_search/ppls/009768-00018-20110630.pdf](http://www.epa.gov/pesticides/chem_search/ppls/009768-00018-20110630.pdf) (label amendment)

U.S. Environmental Protection Agency. 2011. Notice of Pesticide Label Amendment for Aquatic Weed Killer (Xylene). [http://www.epa.gov/pesticides/chem\\_search/ppls/009768-00018-20110630.pdf](http://www.epa.gov/pesticides/chem_search/ppls/009768-00018-20110630.pdf)