

Carbon Dioxide-Carp

A new tool in the invasive species toolbox

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Background

- Need for barriers/deterrents
 - CO₂ could be a non-physical fish barrier
 - Non-selective deterrent
- Recent research
 - Lab studies
 - Pond studies
 - Field study
- Next steps (**FY19 projects**)
 - Registration of CO₂ with USEPA
 - Engineering feasibility study



Carbon dioxide treatments at a water control structure on the Illinois River (Lewistown, IL)

Carbon Dioxide-Carp

- U.S. EPA registered on April 2019
- Current label
 - Restricted to USGS, USFWS, USACE, State Resource Managers, or those under their direct supervision
- Approved uses:
 1. Asian Carp deterrent
 2. Under-ice lethal control

Precautionary Statements:
Hazards to Humans and Domestic Animals

WARNING: May be fatal if inhaled. Do not breathe vapor.

Environmental Hazards
This chemical is toxic to aquatic vertebrates and invertebrates. Non-target organisms may be killed at rates recommended on this label. Directions for use must be strictly followed to minimize hazards to non-target organisms.

DIRECTIONS FOR USE
It is a violation of Federal Law to use this product in a manner inconsistent with its labeling. Read entire label and follow use directions carefully before applying.

Product Information:
This product is used as an Asian carp deterrent or as an under ice lethal control for aquatic nuisance species. Before applying carbon dioxide to water, ensure infusion equipment is in good working condition and there are no leaks. All persons working with this product must be trained in the product hazards, the use of respiratory devices when required, detection instruments, emergency procedures, and product application procedures. Obtain any permits required by Local, State, or Federal authorities before application.

Behavioral Deterrent:
Specific areas within waterways may be treated to induce avoidance behavior to limit the localized occupancy, movement, and spread of invasive carp.

Amount of product applied will depend on water volume to be treated. Target carbon dioxide concentration to induce avoidance behaviors ranges between 100–150 mg/L. To determine weight (W) of product (in kilograms; kg) to infuse, use:

$$W = (C \times V) \times f$$

where C is target concentration (in mg/L); where V is treatment area volume (expressed in liters); and, where f is unit conversion factor for mg to kg (0.000001).

Amount of product applied may vary slightly depending on gas transfer efficiency due to potential loss from biological uptake, effervescence, and other atmospheric losses. With target treatment concentrations ranging between 100–150 mg/L, temporary pH suppression to not less than 5.5 is expected.

For use only by U.S. Fish and Wildlife Service, U.S. Geological Survey, U.S. Army Corps of Engineers, State natural resource managers, or persons under their direct supervision

Carbon Dioxide-Carp

Active Ingredient:	
Carbon dioxide	100%
Total	100%

KEEP OUT OF REACH OF CHILDREN

WARNING

FIRST AID	
IF INHALED	<ul style="list-style-type: none"> • Move person to fresh air • If the person is not breathing, call 911, then give artificial respiration, preferably mouth to mouth if possible • Call poison control center or doctor immediately for treatment advice

Have the product container or label with you when calling a poison control center, doctor, or going for treatment. For non-emergency information concerning this product, call the National Pesticides Information Center (NPIC) at 1-800-858-7378 seven days a week, 6:30 am to 4:30 pm Pacific Time (NPIC Web site: www.npic.orst.edu)

Net Weight: 50 LBS

EPA Reg. No. 6704-95
EPA Est. No. 6704-WI-1

Manufactured for:
U.S. Fish and Wildlife Service
United States Department of Interior
18th and C Streets NW
Washington, DC 20240

Lethal Control:
All vertebrate and some invertebrate species under the ice in the treatment area are expected to die. Amount infused will depend on water volume to be treated. Maintain carbon dioxide concentration of 200 mg/L for a minimum of 96 hours for lethal control. To determine weight (W) of product (in kilograms; kg) to infuse, use:

$$W = (C \times V) \times f$$

where C is target concentration (in mg/L); where V is treatment area volume (expressed in liters); and, where f is unit conversion factor for mg to kg (0.000001).

Ponds/lakes/impoundments can be restocked after pH returns to pretreatment level.

Storage and Disposal

PESTICIDE STORAGE
Store in cool, well-ventilated and secure area. Post as a pesticide storage area. The product may be stored in portable cylinders, portable bulk storage tanks, or permanent bulk storage tanks. Store cylinders upright, secured to a wall to prevent tipping. Do not subject cylinders to rough handling or mechanical shock such as dropping, bumping, dragging, or sliding. Do not use rope slings or hooks to unload cylinders. Transport cylinders using hand truck or fork truck to which the cylinder can be firmly secured.

Bulk storage tanks must be in a cool, well-ventilated and secure area. Post as a pesticide storage area. Do not allow vehicles or other large equipment to bump or collide with bulk storage tanks.

Do not store carbon dioxide containers in areas where there is a potential for electrical discharge. Electrical discharge into the container will cause carbon dioxide to decompose into carbon monoxide and oxygen.

PESTICIDE DISPOSAL
If carbon dioxide cannot be used, vent to open air in an area with restricted access away from people ensuring concentrations don't exceed 5000 ppm.

CONTAINER HANDLING
Return cylinders for reuse or disposal. When the cylinder is empty, close the valve and screw the safety cap onto the valve outlet before returning to shipper or allowing it to be refilled. Only the registrant is authorized to refill containers. Do not use cylinders or bulk storage containers for any other purpose.

Spill or Leak Procedures
In case of leak, evacuate area immediately. Move leaking or damaged cylinders outdoors or to an isolated and ventilated location, observing strict safety precautions. Do not allow entry into spill area by unprotected persons until concentration of carbon dioxide is less than 5,000 ppm. When cylinder is completely empty, return to manufacturer.

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Engineering feasibility study

- Multi-agency research project
- Fox River Navigational System Authority
- August-September 2019

Testing objectives:

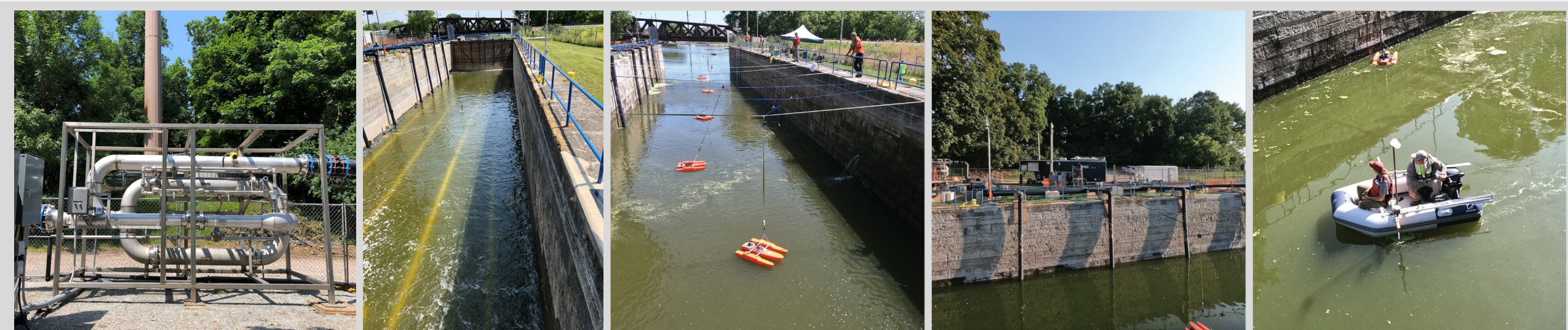
- Engineering and economic assessment
- Effects on water quality
- Air quality (human safety)
- Non-target effects
- Fish behavioral responses



Fox River Lock #2 (Kaukauna, WI)

Engineering feasibility study

- Preliminary results
 - Treatments to 100-150 mg/L CO₂ took ~10 min
 - At warm water temperatures and high algal biomass
 - pH at target concentration for this water body is 6.2-6.4
 - Atmospheric levels much less than OSHA standard (8-h, 5,000 ppm)
 - Low CO₂ concentrations leaving the lock after filling and flushing



Cost estimates

Estimated cost for 1 acre-foot of water						
Target Concentration (mg/L)	Cost (\$/lb CO ₂)	Gas-transfer efficiency (%)				
		50	75	90	95	99
100	0.05	\$27.18	\$18.12	\$15.10	\$14.31	\$13.73
	0.10	\$54.37	\$36.24	\$30.20	\$28.61	\$27.46
	0.15	\$81.55	\$54.37	\$45.30	\$42.92	\$41.19
150	0.05	\$40.77	\$27.18	\$22.65	\$21.46	\$20.59
	0.10	\$81.55	\$54.37	\$45.30	\$42.92	\$41.19
	0.15	\$122.32	\$81.55	\$67.96	\$64.38	\$61.78
200	0.05	\$54.37	\$36.24	\$30.20	\$28.61	\$27.46
	0.10	\$108.73	\$72.49	\$60.41	\$57.23	\$54.91
	0.15	\$163.10	\$108.73	\$90.61	\$85.84	\$82.37

Estimated cost for one lock volume (low water)	
Lock volume (cubic meters)	30,100
Target (mg/L)	150
CO ₂ cost (\$/lb)	0.05
Gas-transfer efficiency (%)	0.95
Estimated Cost	\$524
Total CO ₂ (lb)	10,478

Potential Uses at Brandon Road

- CO₂ is not currently in TSP at BRLD
- Potential applications for CO₂
 - Intermittent use in lock or approach channel
 - Supplement existing deterrents (e.g., electricity, acoustics)
 - Backup plan during scheduled or unscheduled maintenance
- Next steps
 - Data analysis and summaries from Kaukauna lock project
 - State registrations
 - A&E for permanent installations
 - Web platform for Carbon Dioxide – Carp access and reporting (Jan 2020)

Acknowledgements and Contacts

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 - Kim Fredricks, kfredricks@usgs.gov, 608-781-6287
 - Teresa Lewis, teresa_lewis@fws.gov, 608-783-8420
 - Mark Gaikowski, mgaikowski@usgs.gov, 608-781-6221
- Collaborators
 - Suski Lab at University of Illinois-Urbana Champaign
 - Zolper Lab at University of Wisconsin Platteville
 - U.S. Army Corps of Engineers
 - U.S. Fish and Wildlife Service
 - USGS
 - Upper Midwest Environmental Sciences Center
 - Upper and Central Midwest Water Science Centers
- Funding provided by Agency (FWS, USGS) appropriations, and the Great Lakes Restoration Initiative