



Saving Green In A Lab Environment

A White Paper from Smart LabHood Solutions, Inc.

Authors:

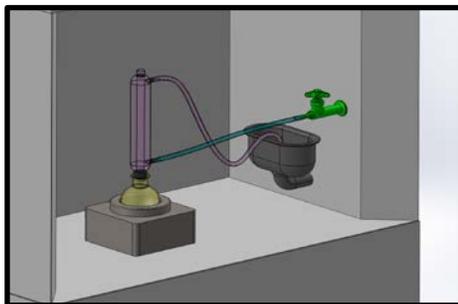
Samuel Prabhakar, Robert Tremain, Dennis VeerKamp, Stephen Sanderfoot, Rochelle Arvizo, Ph.D

Patent: US2013-0331018. *Laboratory Fume Hood System Having Recessed Heat Exchanger System.*

Introduction

In carrying out basic synthetic chemistry, it is necessary to provide cooling to experiments performed in a fume hood to condense volatile components (such as organic solvents), so that they can be boiled but not escape from the containment vessel. The traditional method utilizes a continuous flow of water (from tap-to-drain) for cooling which is wasteful and increases the risk of flooding due to a component failure. Currently, there are commercially available heat exchangers for chemical reactions, but they too are “pass-through” systems as described above.

Traditional Method



With the traditional "pass-through" system, water usage can exceed hundreds of thousands of gallons per year draining into the municipal sewer system. In addition to the water waste and associated costs of this method, there is also the potential danger of hazardous chemicals contaminating the wastewater system.

This issue has been addressed in an Environmental Protection Agency paper titled, "**Environment Management Guide For Small Laboratories.**" In the paper, it states, "*Labs that discharge wastewater to surface water is likely to require a National Pollutant Discharge Elimination System (NPDES) permit.*" It goes on to say, "*Even effluents such as non-contact cooling water are often subject to NPDES requirements.*"

Patented Solution

After a significant facility flood (caused by a lab hood with continuously running water) at a large university in the United States, the researchers involved developed and patented a novel closed loop, heat exchanger system. The system is used in conjunction with a chilled water supply system within the building, providing the necessary temperature to condense volatile components while reducing water waste and the risk of water damage due to backed up drains or leaking connections.

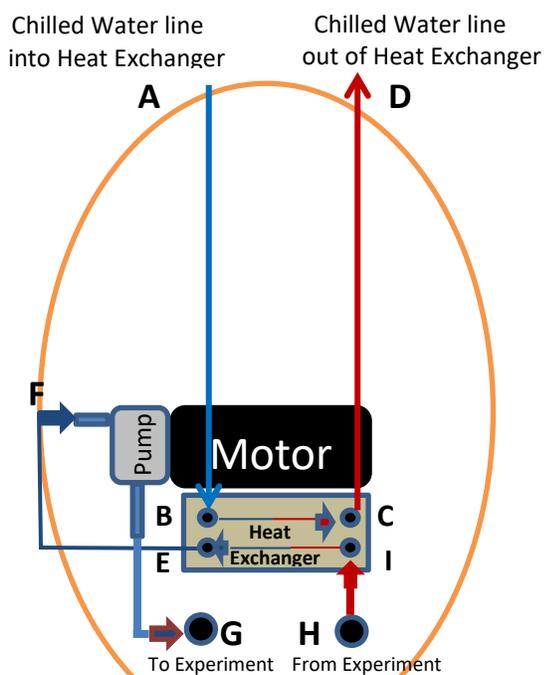
Smart LabHood Solutions, headquartered in Rochester, MN has licensed the patent for this heat exchanger and created the second generation of this product. The design is now more streamlined and modular, fitting between the interior and exterior walls of the fume hood.

Closed Loop System

The EcoDenser is a uniquely designed, closed-loop heat exchanger system installed in-line with a lab hood condenser that is used to cool chemical reactions for an experiment. The EcoDenser consists of a **primary and secondary loop system**. The *primary system* draws chilled water from the facility plumbing network through the heat exchanger on the EcoDenser, cooling the *secondary system* fluid before flowing back into the facility chilled water system. The *secondary system* cycles a fixed amount of fluid through the condenser used for the experiment, into the heat exchanger and back.

Primary Loop System = A-D

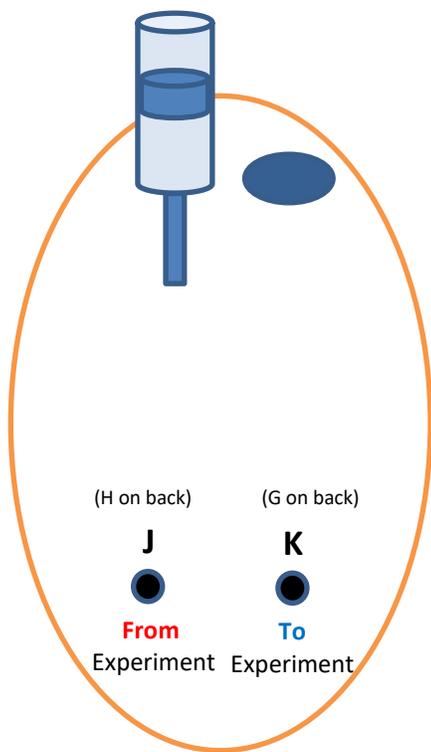
Secondary Loop System = E-K



Back Side of EcoDenser



Closed Loop System (Continued)



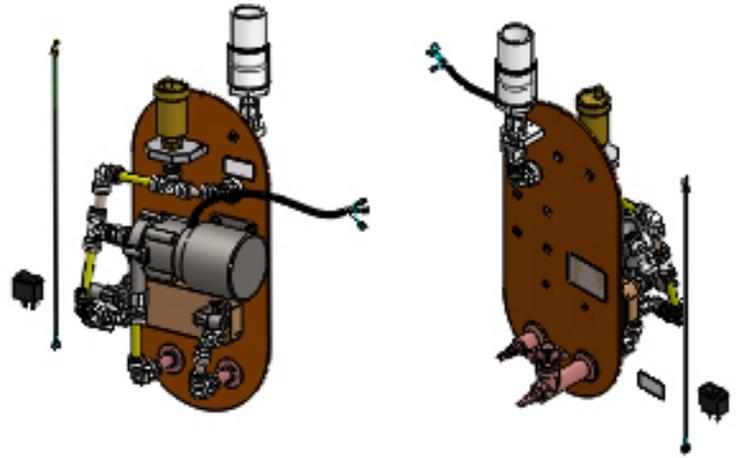
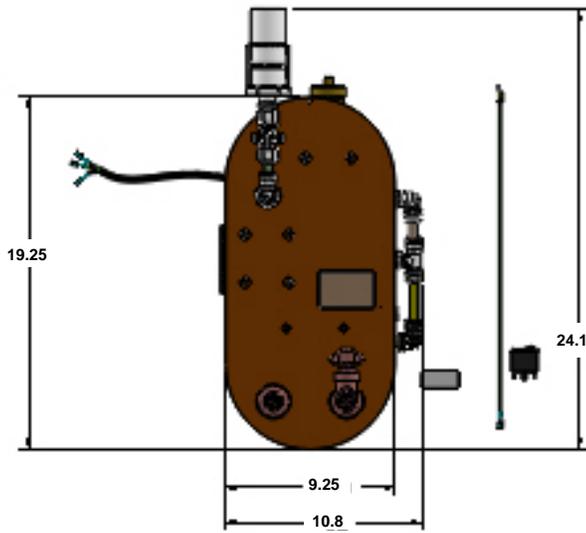
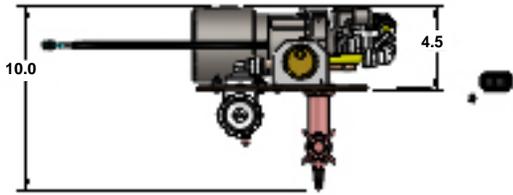
Front Side of EcoDenser



Utilizing this closed loop system eliminates the significant amount of water wasted with the traditional approach of running tap water continuously to cool experiments. It also removes the issue of not being able to maintain a constant temperature from tap water, especially during the summer months. Varying temperatures from a tap could compromise the reliability of the experiments. Put simply, ***the EcoDenser provides a continuous flow of a fixed amount of fluid (typically 16 oz. for a one-condenser experiment) for cooling experiments, without wasting a drop of water.*** Fixed fluid amounts can vary based on the number of condensers used for the experiment.

The EcoDenser meets the functional, safety, and security needs of a modern laboratory by providing an efficient means of cooling equipment with a low risk of failure. It also has the unique ability for retrofitting into existing lab hoods. The EcoDenser delivers environmental and economic benefits as well as simplifies fume hood plumbing (no drains required) and workspace layout. Employing this system may also help a building meet sustainability standards and ensure compliance with water conservation regulations.

Product Components and Dimensions



Highlights

- The EcoDenser is a space and water efficient fume hood solution that utilizes a chilled water supply in conjunction with a condenser to cool laboratory equipment (uses 16 oz. of fluid), reducing a lab's operational costs and risk of flooding. It will also require less maintenance than current fume hood cooling systems.
- The EcoDenser is an easy-to-install system, (about 15 minutes) whether in a new hood or as a retrofit. It is a modular design with all components mounted onto the existing cutout panel built into the hood. The only external hook-ups necessary are for connecting the EcoDenser to the "in and out" ports of a chilled water system. The closed-loop design supports the growing regulatory movement toward sustainable laboratory design.

Benefits

- **Elimination:** Saves hundreds of thousands of gallons of water per year, per lab; "In-Panel" design does not take up valuable lab space. Eliminates expensive plumbing related to drain and sewer connections.
- **Efficiency:** Allows for easy retrofitting of existing fume hoods; Reduces the need for plumbing both tap water and drain; Reduces risks of accidental spillage/flooding.
- **Sustainability:** When used in place of the pass-through method of cooling lab equipment, this system replaces a continuous stream of water with a small amount that recirculates indefinitely. In labs that run experiments for several hours or even days to weeks at a time, this has the potential to save many hundreds of thousands of gallons of water per year.
- **Cost:** In addition to the reduced costs from water and sewer savings, employing this system in a fume hood eliminates the need for a cup sink and faucet within the hood. This elimination may result in net savings in new laboratory construction (i.e., the cost of installing this system could be less than the materials and labor related to sink and plumbing installation). Because the device design allows for installation through the existing knockout panel in a fume hood, the same system can also be easily retrofit to existing labs at minimal cost. This feature is an essential factor in that no modification to the hood is necessary, thus reducing the risk of voiding the manufacturer's warranty.
- **Convenience:** The EcoDenser was designed to be housed between the interior and exterior walls of a fume hood, making it a permanent, integral part of the hood itself. This feature, along with space saved by eliminating in-hood sinks, leaves the user with significantly more workspace and simplifies the process of repurposing or relocating fume hoods.
- **Safety:** By recirculating a small amount of coolant in a closed loop rather than leaving main water line tap open, the possibility of damage from flooding is nearly eliminated, in addition to avoiding the risk of hazardous material going down the sewer.
- **Reliability:** Over the last seven years, the inventors' Version 1 device has been operating in over 80 fume hoods in a major US university with no reported failures.

Return on Investment Examples by Location

EcoDenser usage assumptions per hood (based on chemical experiments utilizing a heat exchanger)

Gallons per Minute:	2
Gallons/Hour:	120
Hours per Day:	4
Days per Week:	5
Weeks per Year:	52
Gallons per Year:	124800
HCF per Year:	166.8449

Note:

Usage is measured in 100 cubic feet units (HCF units). 1 HCF = 748 gallons.
 Cost and savings estimates represent one lab hood.
 HCF rates are derived from each city utility web site (below).

Estimated savings with a new lab hood installation (versus retrofitting an existing hood)

Elimination of:

- Drop-in sink: (\$35.00)
- Goose Neck faucet: (\$215.00)
- Fee to plumb water lines to hood: (\$1500.00)
- Fee to plumb drain: (~~\$1500.00~~)
- Total cost eliminated: \$3,325.00

Note that the estimated cost to hook up (2) lines from the EcoDenser to the chilled water main is \$1500. Subtracting this from the estimated cost elimination of (\$3,325.00), the adjusted cost elimination for a new install (including labor savings) is **\$1825.00**.

Savings Generated Through Reduced Water and Sewer Usage

Location	HCF Used	HCF Rate (Water)	HCF Exp. (Water)	HCF Rate (Sewer)	HCF Exp. (Sewer)	Total Savings/Yr.	New Install HW		
							w/Labor Savings (One-time)	Total 1st Year Savings	2nd Year + Savings
Los Angeles	166.8449	\$4.80	\$800.86	\$4.51	\$752.47	\$1,553.33	\$1,825.00	\$3,378.33	\$1,553.33
Tucson	166.8449	\$3.37	\$562.27	\$3.63	\$605.65	\$1,167.91	\$1,825.00	\$2,992.91	\$1,167.91
Boston	166.8449	\$4.92	\$820.88	\$6.94	\$1,157.90	\$1,978.78	\$1,825.00	\$3,803.78	\$1,978.78
Naperville	166.8449	\$1.31	\$218.57	\$1.85	\$308.66	\$527.23	\$1,825.00	\$2,352.23	\$527.23
Lawrence	166.8449	\$2.75	\$458.82	\$4.65	\$775.83	\$1,234.65	\$1,825.00	\$3,059.65	\$1,234.65
Minneapolis	166.8449	\$3.53	\$588.96	\$3.68	\$613.99	\$1,202.95	\$1,825.00	\$3,027.95	\$1,202.95
Atlanta	166.8449	\$6.16	\$1,027.76	\$15.69	\$2,617.80	\$3,645.56	\$1,825.00	\$5,470.56	\$3,645.56

Product Feedback

Major Lab Hood Manufacturer: *"A necessary solution to address EPA, water waste and flood damage concerns within a facility."*

Major Lab Facility Planning Architect: *"A must have device within lab hoods performing chemical experiments. I will never spec out a hood drain again".*

Major University Laboratory Design and Construction Executive: *"I believe in this solution. The benefits of this device will not only help avoid major water damage in a lab, but the cost savings in water and sewer should provide more than adequate return on investment."*

Summary

The EcoDenser is a uniquely designed heat exchanger system that is installed in-line with a lab hood condenser used to cool the chemical reaction for the experiment. Unlike traditional methods, the EcoDenser utilizes a facility's existing chilled water supply and easily installs within a fume hood side wall. This closed-loop system reduces the complexity and cost of fume hood installations, in addition to substantially eliminating water waste and the potential for hazardous materials entering the municipal sewer system.

Smart LabHood Solutions
3605 Hwy 52 North
Rochester, MN 55901
507-258-6223