



## The Best-Kept Secret for Minimizing Your Energy Costs

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Finishers and families alike have seen their typical steadily rising power bill increase more dramatically in recent years and even months. The national average price for natural gas has nearly doubled since 1999<sup>1</sup> (U.S. DOE), while companies in California and the New England states are paying as much as 0.15 cents per Kilowatt hour for electricity. For finishers, the operational cost of heating, cooling, and ventilating tanks should weigh in more heavily when designing new process lines or even retrofitting existing operations.

The use of mechanical covers over a tank can save heating and cooling losses, as compared to a typical open surfaced tank. Integrating the covers with a well-engineered ventilation system can conserve tremendous amounts of energy required to properly control tank emissions.

For controlling airborne contaminant exposure to employees, the concept is simple. Covering a tank reduces the open surface area, thus limiting employee exposure to the contaminants evolving from the liquid surface of the tank.

### Covering a Tank

Traditional metal finishing lines have open surface tanks. Calculating surface area is a main component of sizing a local exhaust ventilation system. Covering a tank will reduce the exposed liquid surface, reducing the calculated area necessary for properly sizing a ventilation system to control tank emissions.



Figure 1: Tank with cover open.

A lower surface area requires smaller hoods, duct, control device, exhaust fan, and therefore, a decrease in capital and operational costs.

Many companies have tried the use of basic covers over their tanks. This undoubtedly can help, but the number one problem with a simple cover is that it is removable. Removable covers are cumbersome and a hassle for operators to handle.

Chemistry will drip on the floor from where it is taken off the tank to where it is stored. Usually, after about a couple messy weeks of this practice, the covers will remain in storage and never be used again. That very reason is why mechanical covers should be used.

### Mechanical Covers

A mechanical cover is permanently mounted on the sides or back of a tank. Depending upon space constraints, it can be single hinged, double hinged, or double covers, similar to a horizontally mounted bedroom, closet, or French doors. Connected to the cover and mounted to a side wall bracket on the tank is an actuator. The actuator raises and lowers the cover, and can be electromechanical, pneumatic, or hydraulically powered.

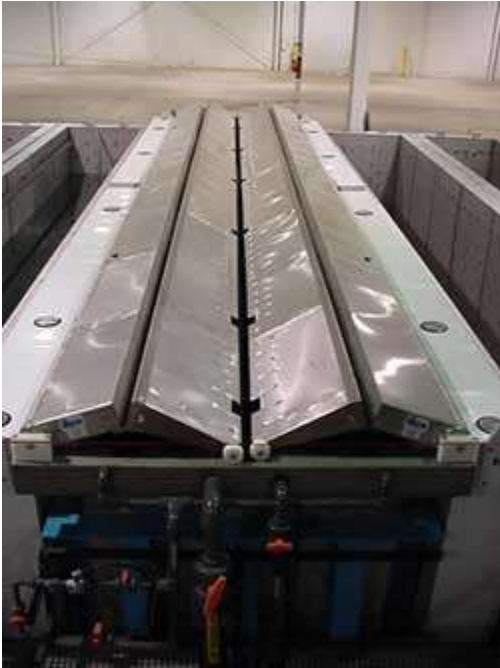


Figure 2: Tank with cover closed.

Most are linear motion, but other types are available. When an operator needs to add or remove a part to be processed, he or she simply presses the up/down push button control mounted on the operator side of the tank, which triggers the actuator to open or close the cover.

Many existing tanks were designed without the idea of being able to cover the process. Therefore, bussing, fixtures, and utilities can make covering a tank very difficult. "Cluster bussing" is popular in some chrome plating shops. A tank can be retrofitted, though, by "cleaning up" the bussing, fixture, and piping configurations. A taller side wall and rim can be welded on top of the existing rim, extending the overall height of the tank, and the freeboard inside the tank. After extending the sidewall, the bussing and utilities can be installed through the new sidewall just below the rim. Now a new cover can be mounted over the new rim along with the exhaust hoods.

An alternative to raising the sidewall of an existing tank is to design a cover with enough depth or height to clear the bussing, fixtures, and utilities. It may need to be notched in certain areas, but the main key is reducing the majority of exposed surface area. Figure 1 shows a tank with the covers open. Figure 2 shows a similar tank with the covers closed.

#### Integrating Covers with LEV Systems

If properly designed, incorporating a local exhaust ventilation (LEV) system with the use of covers can yield significant operational cost savings versus exhausting a line without covers. Tanks with covers incorporate a lateral, low-profile-

type exhaust hood for contaminant control and removal. When a tank cover is in the closed position, the amount of exhaust required to control tank emissions is only a fraction of that when the cover is in the open position. A volume damper in the exhaust hood is interlocked with the cover. When the cover is in the open position, the volume damper is open, increasing the capture velocity through the exhaust hood to properly control contaminants from the open tank surface.

When the cover closes, the volume damper closes, only allowing minimal exhaust at the lateral hood to prevent fugitive emissions from escaping the enclosed tank area. A slightly negative air pressure is maintained inside the enclosed tank area. This also eliminates the risk of hydrogen or other combustible gas explosions, which can form during a plating process.

#### Automatic Hoist Lines

Most automatic lines have one hoist transporting parts from station to station over open surface tanks. Automated mechanical covers with lateral exhaust hoods can be installed to cut down on the total volume of air that is exhausted from the line. As mentioned earlier, the covers are linked to an automatic volume damper in the exhaust hood, which will open and close in tandem with the cover. All covers on the line will be closed, except when parts are being lowered into or lifted from the tank.

Therefore, a ventilation system on a one-hoist automatic line with 10 covered tanks will be sized based on only one cover being open at any one time. That one open tank will be exhausting at full ventilation rate, while the other nine covered tanks are exhausting at a percentage (i.e., 10%) of the full rate. For example, the open tank will be exhausting at 1,000 CFM while the other closed tanks are exhausting at 100 CFM each (10% of the open tank).

The total CFM requirement is calculated below:

Nine closed tanks x 100 CFM each = 900 CFM  
 900 CFM + 1,000 CFM for the open tank = 1,900 Total CFM  
 The same automatic line without the covers would have the following exhaust system size calculation: 10 open tanks x 1,000 CFM each = 10,000 CFM

In this very basic example, the total net savings of using covers is 8,100 CFM, or approximately an 80% reduction in



Figure 3: Automatic lines with covered tanks incorporated with the exhaust system.

system sizing. This is very significant in terms of energy and initial cost savings. Figure 3 shows automatic lines with covered tanks incorporated with the exhaust system.

### A Case Study of Capital & Operating Cost Savings

The U.S. Environmental Protection Agency (EPA) has established an Environmental Technology Verification (ETV) program to assess the performance characteristics of new environmental technologies.

Item	Operational Cost (with covers)	Operational Cost (without covers)	Operational Cost Savings Per Year
Exhaust fan motor	\$8,626	\$21,965	\$12,939
Scrubber pump motor	\$1,438	\$2,875	\$1,438
Tempered make-up air	\$17,898	\$49,395	\$31,507
Operation and maintenance	\$8,547	\$25,641	\$17,094
<b>Totals</b>	<b>\$36,499</b>	<b>\$99,476</b>	<b>\$62,978</b>

A recently installed semi-automatic chemical etch line utilizing covered tanks integrated with local exhaust ventilation was evaluated by an independent contractor in cooperation with the EPA. The evaluation was to verify the performance of the installation and compare the capital and operational costs with that of a traditional finishing line without covers.

As shown in Table I, the test results reveal that utilizing covers result in an operational cost savings of \$62,978 per year<sup>2</sup>. The total operational cost savings are a sum of individual components measured in the test. The components include a reduction in tank heating requirements, air volume, and pump and fan horsepower. Also included is a reduction in operation and maintenance costs due to reduced chemicals, water treatment, scrubber filter replacement, and labor.

An additional \$61,283 was also saved in initial capital costs due to the smaller sizing of the fume scrubber, scrubber pump, ducting, exhaust fan, and installation cost.

The covered tank system above has been verified by the EPA/ETV program to be a proven method for energy conservation. Further information on this study can be accessed on the EPA Web site at <http://www.epa.gov/etv/verifications/vcenter6-12.htm>

### Reducing Employee Exposure

As many know, the Department of Labor's Occupational Safety and Health Administration (OSHA) has proposed a new standard for occupational exposure to hexavalent chromium. The proposed standard will drastically reduce the permissible exposure limit (PEL) from 52 µg/m<sup>3</sup> to 1 µg/m<sup>3</sup> based on an eight-hour time weighted average.

If the proposed standard is passed and implemented, finishers using processes containing hexavalent chromium may be required to upgrade or replace their existing local exhaust ventilation systems to meet the new standard. Retrofitting tanks with mechanical covers linked to a properly engineered exhaust system will provide a means of lowering employee exposure to hexavalent chrome.

### Summary

The importance of protecting the worker from hazardous chemical exposure outweighs all other factors when designing an industrial ventilation system. A complete understanding of airflow and controlling tank emissions is required. Incorporating a properly designed exhaust system, with automatic covers and volume dampers operating in tandem, can create tremendous pollution prevention and energy savings, especially today, where energy costs alone could make the difference between profit and peril.

### References

1. U.S. Department of Energy, Energy Information Administration, *Annual Average U.S. Energy Prices: Base Case*, [www.eia.doe.gov](http://www.eia.doe.gov).
2. Environmental Technology Verification Report, *Evaluation of the KCH Services, Inc. Automatic Covered Tank System for Energy Conservation*, 2002, Concurrent Technologies Corp., U.S. EPA, [www.epa.gov/etv](http://www.epa.gov/etv).

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