Chemical Strategies Partnership™

# Chemicals Management Services open the door to process efficiency improvements and cost savings in metal fabrication

Auto manufacturers generally do not think of themselves as experts in chemical management. That is why nearly 20 years ago General Motors decided to contract out the management of its chemicals (metal removal fluids, metal forming fluids, lubricants, greases, adhesives, paints, compressed gasses, etc.) to a skilled practitioner of chemical management services (CMS).

GM's CMS provider was entrusted with purchasing, delivering, and inventorying its chemicals, as well as facilitating all environmental reporting and data tracking. By sticking to its core business of manufacturing vehicles and allowing its CMS provider to take on the task of managing chemicals, GM has realized a 30% reduction in chemical use and a 30% reduction in the cost of purchased chemicals and associated management activities.[1] CMS has been implemented in nearly 90% of GM's plants worldwide.

## What is CMS?[2]

Chemical services are a range of chemical management activities that are contracted to a chemical service provider, or Tier 1 supplier. A chemical service provider may be a chemical supplier, waste hauler, or environmental engineering firm that offers a range of services to manage a company's chemicals. They may purchase and deliver chemicals, maintain the inventory, and track MSDSs. They also may provide a broader range of services including process efficiency improvement, data collection for environmental monitoring and reporting, and waste collection. These chemical services are often performed more effectively and at a lower cost than companies can do by themselves.

The chemical service model delivers results by aligning the incentives of chemical suppliers and their customers. The supplier's profitability is independent of the volume of chemicals sold. In other words, the suppliers no longer get paid based on how well they can sell, but how well they can manage. This is accomplished by establishing supplier compensation on performance-based metrics and fees. This is what makes chemical service a "service-based" model (see Figure 1).

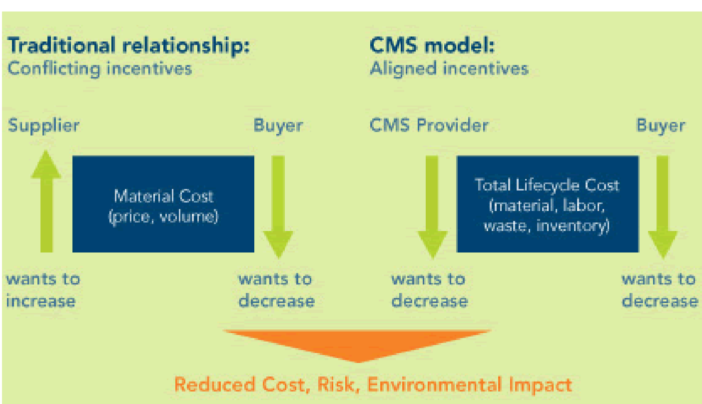



Figure 1. Aligning incentives

[1] Chemical Management Services Industry Report 2004, p.19.
[2] Chemical Strategies Partnership (http://www.chemicalstrategies.org/implement_whatiscms.htm)

Generally, chemical service providers begin by offering a narrow range of chemical management services. That is, they don't start out in client companies by taking over management of all chemical needs. For example, a chemical service provider might purchase and deliver chemicals, manage MSDSs, pick up waste, and provide data for some environmental reports. Later, they might expand their work scope to include such services as research for chemical substitutes and process efficiency improvements. "When the customer/supplier relationship reaches a level of mutual trust and respect, the supplier can then begin to truly integrate itself into the customer's internal processes and identify greater opportunities for reducing their use of chemicals, lowering costs, and changing processes to improve performance." -- Laura Wolfson, Chemical Strategies Partnership.

## Case Study: General Motors Grand Rapids Metal Fabrication Plant

The General Motors Grand Rapids Metal Fabrication Plant houses four operational areas in its 2,000,000 square foot facility: Tool & Die Operations, Blanking, the PressRoom, and Metal Assembly. The PressRoom is where automotive body/structural parts are formed, some of which are welded together in Metal Assembly before being shipped to an assembly plant. Many pieces of equipment used throughout the plant require cooling, which is carried out by way of a large (~180,000 gallon) closed-loop cooling water system. The cooling water system (also called the welder water system) circulates through a massive matrix of piping that covers the entire plant, cooling various equipment/systems such as hydraulic systems, clutch systems, hundreds of welding robots, weld guns, and controllers (see Figure 2). This matrix consists of pipes and hoses that vary in size from ten-inch mains all the way down to half-inch hoses and smaller orifices.

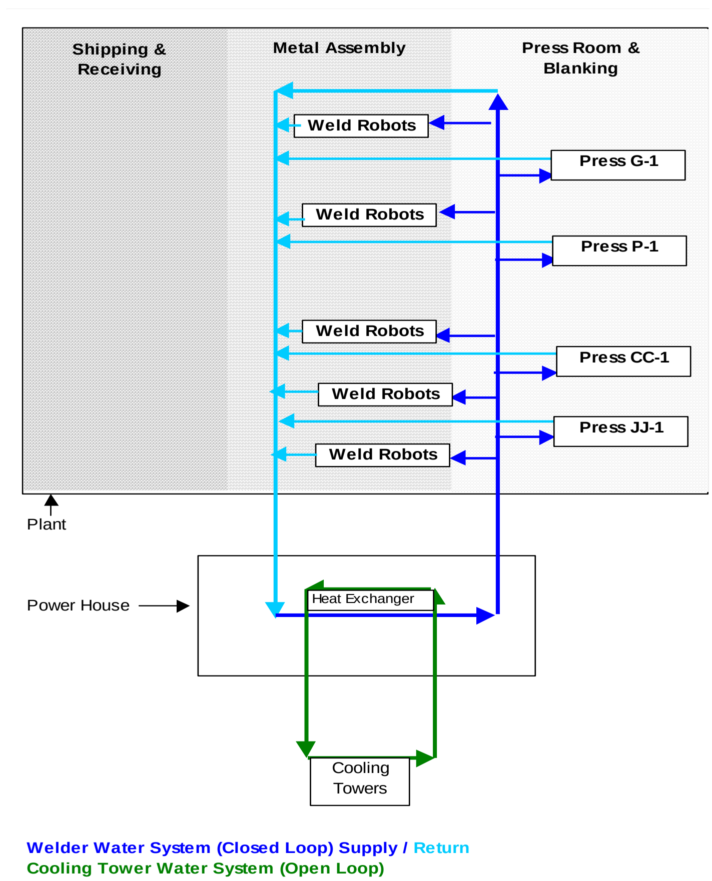



Figure 2. Simplified cooling water flow diagram

**Problem Statement:**

Around the year 2000, Metal Assembly began experiencing unusual equipment failures. The kickless cables (weld cables) on the welding robots would become completely clogged, sometimes to the point of splitting. They continually experienced low-flow faults to the robot welding tips. These issues led to production downtime as equipment parts were replaced and repairs made. Another complaint - perhaps the largest - was from the maintenance personnel. They complained of an unpleasant odor coming from the cooling water as they made the repairs (see Figure 3).

Figure 3. Dirty and clean cooling water samples

**Partnership:**

Quaker Chemical Corporation's relationship with this General Motors plant began in 1998, with a contract to provide chemical management services (CMS) at all twelve US GM metal fabricating facilities. During the first few years of the contract, a basic chemical management program was in place. Quaker assumed management of all oils and greases for the plant (price comparison shopping, purchasing, maintaining appropriate inventory levels, and tracking usage throughout the plant) as well as condition monitoring of the blank wash fluid used in the metal forming process. The focus of the program was to reduce the chemical spend for the plant.

In 2003, Quaker was awarded a second, expanded-scope contract with GM, and chemical management became more integrated into the plant itself. The number of chemicals managed by Quaker grew to include practically everything – paint pens, glues, and welding rods, among other items. Quaker also became responsible for managing the plant's MSDS system – a record management and retention system for every chemical item used in the plant. Chemical usage and cost were significantly reduced by implementation of several projects led by the chemical manager, making it difficult to achieve additional chemical savings.

By the end of the second contract term, all of the "low hanging fruit" had begun to disappear, and GM staff members wondered whether their CMS program could deliver any additional benefits. Chemical costs were at their lowest possible levels, eliminating the possibility of squeezing out any more savings.

In 2007, Quaker was awarded a contract renewal with GM. This chemical management contract was structured in a way that encouraged the chemical manager to look beyond strictly chemical savings; it allowed the chemical manager to go after process savings as well. At this point Quaker had been in the plant for nearly ten years. In working together for so long, the customer and chemical manager at the plant level felt and acted as though they were working for the same company with a common goal: to optimize chemical management and reduce costs. The customer trusted Quaker to know and be a part of GM's process and procedures. This level of confidence has led to an open exchange that benefits both parties.

As Roger Chmura P.E., Operations Manager for Quaker, stated: "When all the low-hanging fruit is gone, we need to grow closer to the customer and their manufacturing/reporting processes, to discover what can be improved upon to be of even greater value to the plant." This is reinforced by an excellent working relationship with the customer, in which the customer knows and trusts that its CMS provider is working in their best interest. It was this relationship that helped GM succeed in tackling this cooling water system glitch.

**Why now?**

There was general consensus that the cooling water system in the plant was contaminated with oil. On multiple occasions Metal Assembly complained, the problem was examined, and meetings were held involving plant engineers, plant maintenance, Metal Assembly supervisors, chemical management, the wastewater treatment provider, and the oil supplier. Many suggestions and ideas were recorded during these meetings, but none of them succeeded in resolving the cause. The meetings always ended without a true plan; thus the contamination issue would fall off the agenda until Metal Assembly complained again, and the cycle would start all over again.

The CMS provider was involved primarily due to its relationship with the cooling water treatment provider and the oil supplier. The CMS provider is a "value added resource" within the plant. After ten years of trusted service, the customer has come to accept the chemical manager as part of the team. As part of the team, the chemical manager was invited to a problem-solving class held by the customer. The class introduced the chemical manager to a methodology GM calls "Statistical Engineering" – a disciplined philosophy of root cause convergence based on strategy and contrast. Statistical Engineering had typically been used for solving quality and warranty issues, but by training the chemical manager, the scope had been broadened.

Once the chemical manager was trained in Statistical Engineering, the chemical manager analyzed the cooling water contamination issue from this new, skilled viewpoint. By applying the Statistical Engineering methods of the customer and working closely with many people in the plant, a true solution was finally realized; the trusting relationships, a deep knowledge of the systems, access to process information, and speaking the plant's problem solving language had all come together.

"Training the chemical management supplier in technical problem solving has been one of our best investments – after training they hit the floor running, identifying several growing problems. They were able to gain an understanding of how the problems worked and, through engineering, come up with irreversible corrective actions. Their efforts have saved us money and improved the environment simultaneously." -- Phil Brooks, GM Statistical Engineering Master.

**Results:**

The Statistical Engineering project initiated by GM's CMS provider was based on the problem statement: "Find and eliminate the root cause of contamination in the cooling water system causing downtime in Metal Assembly." By following the Statistical Engineering methodology, the CMS provider was able to identify what the contamination actually was (see Figure 4), where it was coming from, and how to stop it. The problem had to do with heat exchangers (see Figure 5) on high-pressure hydraulic systems – not the units themselves, but rather with the plant's start-up procedure. "Utilizing the Statistical Engineering process, the chemical manager was able to prove where and how oil was contaminating the plant's cooling water. We had previously suspected the heat exchangers, but our conventional testing methods were unable to detect the leaks." – Steve Andreen, Manufacturing Engineering Director, General Motors. Once the contamination was stopped, the CMS provider began the process of cleaning out all of the residual contamination left in the cooling water system.

**Sample Comparison**

**Common Plant Oils vs. Cooling Water**

| Elements (ppm) | Safety-Kleen AW-46 (Hydraulic Oil) | DTE 24 (Hydraulic Oil) | Vacuoline 533 (Gear Oil) | Safety-Kleen EP 220 (Gear Oil) | Vacuoline 537 (Gear Oil) | DTE Oil AA (Gear Oil) | Mobilfluid 350 (Torc-pac Oil) | Mobilgard 450 NC (Torc-pac Oil) | Cooling Water Sample |
|---|---|---|---|---|---|---|---|---|---|
| Fe - Iron | - | - | - | - | - | - | - | - | 184 |
| Cu - Copper | - | - | - | - | - | - | - | - | 218 |
| Pb | - | - | - | - | - | - | - | - | - |
| Sn - Tin | - | 1 | - | - | - | - | - | - | - |
| Cr | - | - | - | - | - | - | - | - | - |
| Al | - | - | - | - | - | - | - | - | - |
| Ni | - | - | - | - | - | - | - | - | - |
| Ti | - | - | - | - | - | - | - | - | - |
| Ag - Silver | - | - | - | - | - | - | - | - | 1 |
| V | - | - | - | - | - | - | - | - | - |
| Mg - Magnesium | - | - | - | - | - | - | - | 7 | 3 |
| Si - Silicon | - | - | - | - | - | - | 12 | 2 | 3 |
| B - Boron | - | 1 | - | - | - | 1 | - | - | 27 |
| Na - Sodium | - | 4 | - | - | - | - | 12 | - | - |
| Ba - Barium | - | - | - | - | - | - | 6120 | - | - |
| Ca - Calcium | 51 | 126 | 109 | - | 88 | 89 | 2 | 4188 | 43 |
| P - Phosphorus | 370 | 502 | 442 | 170 | 289 | 361 | 853 | 4 | 99 |
| Mn | - | - | - | - | - | - | - | - | - |
| Zn - Zinc | 490 | 711 | 579 | - | 394 | 440 | 963 | - | 64 |
| Mo | - | - | - | - | - | - | - | - | - |
| Cd | - | - | - | - | - | - | - | - | - |
| K - Potassium | - | - | - | - | - | - | - | - | 5 |
| Viscosity (cSt @ 40) | 46.17 | 32.65 | 219.00 | 216.00 | 319.00 | 310.00 | 42.68 | 141.00 | 71.57 |

A cooling water sample was collected from a location near GMX211. This sample was sent to the lab where they isolated the "oil" layer for analysis.

Close Match | Eliminated as Possibility | Internal System Degradation

Figure 4. Identifying the contamination

Image source: www.heatexchangers.org

Figure 5. Heat exchanger detail

The effects were dramatic and nearly instantaneous. Oil usage in the suspect systems decreased (see Figure 6), reducing the plant's overall oil consumption. Metal Assembly no longer experienced blown cables or clogged water lines, greatly reducing production downtime and maintenance costs. Pipe-fitters no longer needed to drain sections of the cooling water system on overtime. No longer were totes of black, foul-smelling water being sent to the plant's wastewater treatment building for disposal, and no longer was the plant's Utility Manager required to add large amounts of corrosion-preventing chemicals to the cooling water system in order to maintain the required levels. The plant's water usage decreased, as did the amount of water the plant sent to the city for treatment.

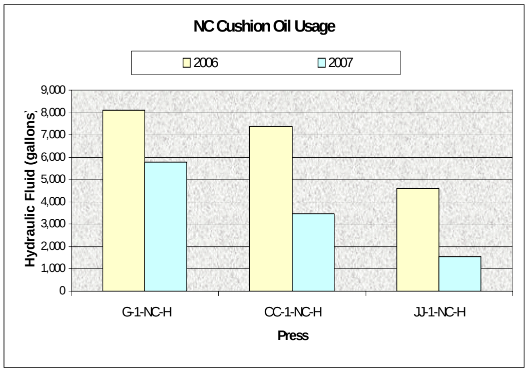
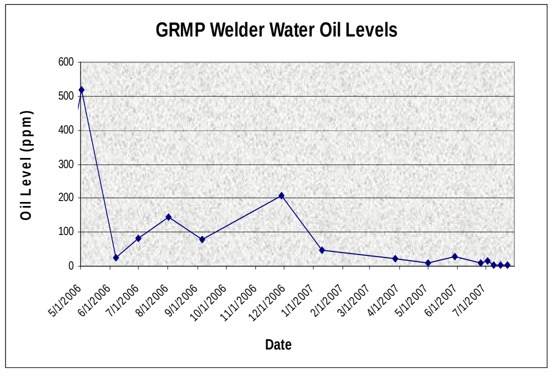



Figure 6. Oil usage decreased in suspect systems.




Overall oil levels in the cooling water system dropped.

The financial benefits of this project amounted to over $800,000 annually. In addition, significant environmental and personnel benefits were realized through reductions in chemical use, waste, overtime, downtime, and odor. "The partnership between GM and Quaker here at Grand Rapids has taken the Chemicals Management paradigm to a whole new level. The program is producing significant measurable benefits, not only to the bottom line, but also to GMs ongoing commitment to its Environmental Principles, as well." -- Scott Murto, Sr. Environmental Engineer, General Motors.

## Conclusion

Partnering with an expert to manage your industrial chemicals can deliver significant benefits, both in terms of hard cost savings and improved efficiencies. CMS is a growing trend that has not only penetrated the automotive and auto supply markets, but has also proven successful in nine other industries spanning from aerospace to electronics to the pharmaceutical sector.

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**About General Motors**

As a responsible corporate citizen, General Motors is dedicated to protecting human health, natural resources and the global environment. This dedication reaches further than compliance with the law to encompass the integration of sound environmental practices into our business decisions. One aspect to achieve this practice is through the incorporation of a competent chemical manager. This article reflects one of many instances where, working as a unit, the site personnel and a chemical manager can coordinate efforts and 'root out' a cause to effect a better outcome – this case, improved operating efficiency and elimination of a source of waste. For more information, visit: http://www.gm.com/corporate/responsibility/environment/principles/index.jsp.

**About Quaker**

Quaker Chemical Corporation is a leading global provider of chemical management services, process chemicals, chemical specialties, and technical expertise to a wide range of industries promoting environmental as well as chemical resources stewardship. Their products, technical solutions, and chemical management services enhance customers' processes, improve their product quality, and lower their costs. For more information, visit www.quakerchem.com.

**About Chemical Strategies Partnership**
The Chemical Strategies Partnership (CSP) is a non-profit research, education and consulting organization which seeks to reduce chemical use, waste, risks, and cost through the transformation of the chemical supply chain by redefining the way chemicals are used and sold. For more information, visit www.chemicalstrategies.org.

**The Authors of this Article:**


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In addition, Ms. Wolfson serves as an Associate at California Environmental Associates. Prior to joining CSP, Ms. Wolfson worked at the Sustainable Business Institute, a nonprofit organization promoting socially and environmentally responsible practices in business.

Ms. Wolfson holds a B.A. in Economics and Environmental Studies and a minor in Legal Studies from Washington University in St. Louis.

Phil Brooks has been with General Motors for thirty-five years and is currently the Plant Master Statistical Engineer at the Grand Rapids Metal Fabricating Plant. In this role, Mr. Brooks has the opportunity to work on and solve a wide variety of problems in order to better the company.

Mr. Brooks is a Certified Quality Engineer, registered with the American Society for Quality. Just prior to his current position, Mr. Brooks was a Reliability Engineer. Other positions previously held by Mr. Brooks include WM Electrical Troubleshooter and Welder Maintenance Journeyman.

Mr. Brooks holds a Journeyman Plumber license with the State of Michigan.

Amy Johnson is a Site Engineer for Quaker Chemical Corporation, currently assigned to the GM Grand Rapids Metal Fabricating Plant. In this role her main responsibilities are maintaining all metalworking fluids throughout the plant, tracking and monitoring oil usage, analysis of lubricating oils, and cost savings projects.

Ms. Johnson's previous assignment with Quaker was as Site Coordinator at the CSN steel mill in Terre Haute, Indiana. Amy is currently working towards degrees in Mechanical Engineering and Chemistry.