

Tier I integrator's strategy has sweet smell of success

As anyone in the aviation industry will tell you, details are everything. From the Wrights' first airplane to today's highly engineered spaceships, every component is mission-critical to the performance of the aircraft. So it came as no surprise to the facility supervisors at Vought Aircraft Industries Inc. that a seemingly minor consumable product such as the coolant it uses in its manufacturing processes could considerably affect production output and costs.

Vought, headquartered in Dallas, TX, is a major independent producer of aerostructures. The company employs more than 6,000 people at eight locations and generates more than \$1 billion in annual sales. A Tier I integrator to the aerospace industry, Vought manufactures large, complex, turnkey assemblies such as tail and wing sections, nacelles, thrust reversers, and fuselage sub-assemblies for both commercial and government organizations. Boeing, Airbus, Gulfstream, Lockheed Martin, Sikorsky, Cessna, and the U.S. military all rely on Vought for its precision design and manufacturing.

The company's two main machine shops in Dallas have hundreds of cutting, milling, grinding, routing, and drilling machines, as well as lathes, drills, and routers for machining aluminum, titanium, and Inconel. In Building 6, more than 200 machines are in operation, while Building 1 houses approximately 35.

Despite the highest quality product output and an impressive 95 percent machine uptime, Vought determined there was still room for improvement. It was time to address a nagging problem that had surprisingly widespread effects — foul coolant.

Vought was hardly alone in dealing with souring coolants — it's a headache that bedevils the metalworking industry worldwide, especially at facili-



This Makino A99 horizontal machining center is used for high-speed machining of small parts at Vought Aircraft Industries Inc.

ties that utilize large, centralized coolant systems.

At Vought, the problem was magnified because of the size of their machining operation. Sourcing coolants represented a significant portion of production costs. The facility's 235 stand-alone coolant sumps and three central coolant systems collectively hold more than 60,000 sump gallons of coolant, and Vought plans to increase capacity by 80,000 gallons in the foreseeable future.

For more than 20 years, Vought maintenance personnel consistently conducted trials on new coolant technology, but never found a solution. "We avoided downtime at all cost and lived with the smell until the weekend, when we would try various fixes to rebuild the coolant in the system," says Bob Murphy, production manager of Building 1.

Building 6 fared no better. "Coolant-related issues were the leading cause of unplanned downtime," says Lanny Shirk, production manager of Building

6. "To make up for the delays, we ran machines through the weekends. We also worked four to five employees on Saturday and Sunday."

Abruptly, the need for better coolant technology escalated in April 2004. An unstable coolant condition in one of the central systems caused Vought to shut down the entire Building 1 facility for half a day. The company was forced to dump and recharge the entire 13,000-gallon system. This costly incident moved Vought to launch a renewed effort to find a new coolant technology.

"Coolant had been an ongoing issue for years," says Robert Nixon, the process control engineer at Vought who led the charge to find a coolant solution. "The frequent and unsuccessful attempts to find just the right fix were tiring and frustrating. We had already been putting up with the stench and the mess, but now the expenses were getting too great to ignore. Finding a solution became a top priority."

Combating coolant

Vought knew firsthand just how expensive coolant-related problems could be. “Most people in the industry think of coolant cost as the cost per gallon of coolant concentrate. They usually don’t think of all the items needed to keep coolant clean and performing properly. And they almost never consider the costs of dealing with poor coolants — constant maintenance to clean residue off of tools, parts, and machinery — and expensive dumps, disposal costs, and coolant recharges. Those numbers are significant,” says Nixon.



A two-spindle, three-axis Cincinnati skin mill, machining an upper wing skin section

To minimize costs, facility supervisors employed every means possible to extend the life of the coolant, particularly in the central systems. Vought used drag chains to pull out metal chips and filings to help keep the coolant as clean as possible. Vought also purchased a large centrifuge to remove tramp oil and rotated it among the different systems, diverting some of the coolant to the centrifuge where it was cleaned and returned to the flow — a process that takes three to four days.

In addition, Vought personnel conducted regular coolant checks for concentration level, pH level, and traces of bacteria. Vought lab technician Laura Marbut was pulling coolant samples from 16 systems each Thursday, analyzing them for concentration, pH, and biometric readings, and running Grotan tests for biological activity. These activities, plus the resulting discussion of possible fixes with plant staff, consumed more than 10hr of Marbut’s time each week.

“It was a big headache, and very frustrating because it was always difficult to pinpoint the cause of the problem. Maintenance was coming in three times a week with questions and concerns from the floor, and I couldn’t

always answer them,” Marbut says.

To combat bacteria, Vought topped off its coolant tanks with expensive additives such as biocides and defoamers every few months.

Despite these extensive efforts, the central systems had to be dumped at least annually, and in some cases every six months. Many of the stand-alone sumps had to be changed every month or two. “In our facility, the 9,000-gallon system went bad on average once a year over the last 12 to 13 years,” says Johnny Rodgers, Vought facility maintenance supervisor in Building 6.

In addition to the coolant waste, disposal expense, and costly downtime,

The new technology didn’t just reduce Vought’s coolant disposal costs, it eliminated them entirely. By Vought’s estimates, it had been dumping more than 200,000 gallons of coolant per year, with disposal costs alone exceeding \$150,000. Since the introduction of the Hocut coolant, the central systems have not yet needed to be emptied, cleaned, and recharged.

Vought machine operators voiced complaints about the foul smell and mess, and wondered about potential health hazards in their work environment. Vought’s health and safety personnel monitored the situation closely and took the necessary steps to ensure employees were provided a safe environment in which to work.

Another impact of sour coolant was one that affected both the productivity



Vought process engineer Robert Nixon checks a centrifuge that performs periodic cleaning of four of Vought’s flumes.

of Vought’s machines and part-reject ratios. The souring coolants left a gummy film on Vought tools and machines. The sticky residue permeated the crevices of machines, causing failures and consequent downtime to clean or repair them. This residue also attached to machined parts, requiring them to be tumbled in order to remove the residue. The process was cumbersome for the operators as well as inspectors in the statistical process control (SPC) area.

New coolant technology

Less than a month after the half-day plant shutdown in Building 1, Vought began a trial of a new coolant technology — Houghton International’s Hocut 795-B. The technology had previously earned the approval of Boeing, one of Vought’s largest customers, and is widely used on production floors, including some of the largest Tier I and Tier II suppliers to the aircraft and automotive industries.

“We decided to conduct trials on the coolant in two opposite equipment scenarios for six months,” says Murphy. “We wanted to test how it performed in a machine that runs constantly and in one where it sits unused for extended periods of time.” The team selected a Makino high-speed aluminum cutter that sees daily use, and a Bullard vertical lathe that runs specialty Inconel jobs only six to eight hours per month.

“Houghton worked with us to monitor the coolant every week, and the weeks continued with no problems with either machine,” adds Murphy. The bacteria problems had been eliminated

coolants

and, with them, the annoying odor and concerns about the workplace.

After a successful six-month trial, Building 1 began systematically changing its entire facility to the Hocut technology. As systems using the previous coolant went bad, maintenance recharged them with the new coolant. Building 1 was entirely converted, with all of its stand-alone machines using the new coolant for over a year. "I just haven't been able to figure out a way to make this coolant go bad," notes Nixon.

The maintenance staff noticed improvements too. "Coolant can cause a lot of maintenance headaches," says Jim James. "Motors got gummed up and burned out. Machinery would suddenly fail. Operators would constantly ask us to do something about the smell. Now we can focus on what we do best — keeping the lines up and running."

Machinery also remained cleaner after the conversion. Operators who once had to clean glass on the machinery three or four times a day now rarely need to. They also noticed an improvement with

leave a wax-like buildup on the filters as past coolants had, Vought needed to change them only once every three to four months, instead of every few weeks.

Drop in downtime

During the same time that Building 1 conducted trials on the new coolant, Building 6 needed to recharge its 9,000-gallon central system. The company decided that the timing was right to try out the new technology. They put the coolant into service in July 2004 and two years later have not yet needed to replace or recharge it.

With the new coolant technology in use at all of its Dallas metalworking facilities, Vought has reduced its coolant usage from an average of 47,520 gallons in 2002 to 23,540 gallons in 2005.



An Ingersoll spar mill is used to machine a stringer, using Houghton International's Hocut 795-B coolant technology.

a positive effect on the bottom line.

"We haven't stopped production to clean the machines once since making the switch over a year ago. And the maintenance effort has dropped by at least two-thirds," says Rodgers. According to maintenance supervisors, Vought no longer needs to add any biocide; they have never had a bacterial, pH, or biocide problem; and none of the central coolant systems' concentrations drop below 5 percent.

The new technology didn't just reduce Vought's coolant disposal costs it eliminated them entirely. By Vought's estimates, it had been dumping more than 200,000 gallons of coolant per year, with disposal costs alone exceeding \$150,000. Since the introduction of the Hocut coolant, the central systems have not yet needed to be emptied, cleaned, and recharged. Nixon says he cannot predict when, or even if, that may be necessary, because he has no history on which to base a forecast.

"To this point, the coolant has been performing at least as well as expected, if not better. We will probably change out the stand-alone systems once per year, maybe a bit more frequently than that, depending on their functions and preventive maintenance schedules. As for the central systems, I can't plan the next change-out until I've seen the first one, and I've seen nothing to suggest that we'll need one anytime soon. What I do know is that my level of intervention regarding coolants and additives has dropped to zero, and that makes me one happy guy."

Machine downtime also decreased. "Not only does the new coolant run cleaner, it actually cleaned the gummy



Mixing station that serves Vought's 13,000 gallon flume

the machined parts themselves. "Parts used to get stained if the coolant wasn't wiped off right away. By the time it got to our cleaning process, it often was too late. That isn't an issue any more," adds James.

Building 1 also noted fewer filter problems in their central coolant systems. Because the new coolant does not

Vought expects to realize further cost savings in the future, since much of the coolant usage in 2005 was the one time start-up cost to recharge the systems with the new coolant. Reducing the frequency of coolant changes also resulted in less downtime, less unplanned maintenance, and less money spent on waste management — all of which had



An aircraft bulkhead on a 3-spindle, five-axis Cincinnati gantry, during the machining process

residue left on machines from the old coolant. Now I have much less downtime from coolant-associated equipment failures,” says Murphy. Building 6’s production manager agrees. “Uptime increased because machines and parts no longer get sticky,” agrees Shirk. Production always used to run behind because of unscheduled downtime to fix coolant issues, but now we are able to handle a greater production load without extra personnel.”

Although it has little financial significance, another benefit of the new coolant has been that the “rotten egg, stinky locker room” stench that once permeated Vought production facilities is gone. “No one complains of a smell anymore, and that’s important to me. Improving employee morale and job satisfaction is always part of the mission and benefits all of us, both individually and collectively,” says James.

Looking ahead

Vought’s goal is zero downtime, so the company continues to explore new preventive maintenance techniques that maximize productivity. Vought is now looking to install a recycling system at the facility to improve its coolant management even further. “We’d like to have a holding tank on site where we could pump the coolant from the stand-alone sumps,” says Murphy. “A recycling system would remove the tramp oil, and then return the ‘clean’ coolant back to the sump.”

The company is still surprised at how such a minor mechanical element like coolant usage could affect plant operations. “Who would have guessed

that going to a ‘more expensive’ coolant would save us so much money?” concludes Nixon. For Vought Aircraft Industries, it’s truly all in the details. **Houghton International, www.rsleads.com/612tp-153**