Case Study	**Outboard Marine Corporation (OMC)** **Substitution for Chromate Conversion**
Standard Industrial Classification (SIC)	Marine Engine Components/3519
Type of Waste	Chromium
Strategy	Process Modification
Company Background	Outboard Marine Corporation (OMC)-Milwaukee employs 400 people and manufactures many of the components used for production of the Evinrude and Johnson outboard engines. The Milwaukee manufacturing facility has roots in the Milwaukee area dating to 1921. The manufacturing operations include machining, heat treating, investment casting, polishing and electroplating operations. The operations with the most impact on hazardous waste generation, and the greatest potential for reductions, are the electroplating and chemical coating operations. The OMC-Milwaukee facility has an aggressive hazardous waste reduction program in place. The facility has targeted Chrome (VI) for elimination.
Original Process	OMC used conversion coating on aluminum propellers prior to powder painting. The process serves two functions. First, the conversion coat enhances the corrosion resistance of the aluminum. Second, it prepares the surface for powder painting and acts as a primer.
Scale of Operations	In 1993, OMC began a world-wide restructuring of its facility manufacturing capacity. The restructuring transferred complete responsibility for production of aluminum propellers (except die casting) to OMC-Milwaukee. This included transferring the chromate conversion coating line.
Motivation	The OMC-Milwaukee facility had already initiated pollution prevention projects to eliminate chrome (VI) from the facility by eliminating various chrome plating baths.
Pollution Prevention Process	The original process was a chromate conversion coating in which the chromate bath contained both trivalent and hexavalent complex chrome salts. The process modification substituted a conversion coating bath containing cobalt to replace the chromium salts.
Development	The requirements for the conversion coating of aluminum are contained in product engineering specifications issued by OMC. The engineering group was approached about substitutes that they had been testing; two processes appeared promising. Engineering agreed to a program where OMC-Milwaukee would provide coated and painted samples from the new processes for evaluation. They also agreed to accelerate paint adhesion and corrosion testing. Testing was initiated in September, 1993, with the understanding that a final decision would be made by November, 1993. This left the minimum time required to purchase chemicals and make equipment modifications prior to the actual transfer and the start of production in January, 1994. Testing of Parker-Amchem "Alodine 2000"

	indicated that this product provided both paint adhesion and corrosion resistance equal to the chromate bath currently in use.
Material/Energy Balance	***Original Process*** For an industrial wastewater treatment plant with a flow of 10 gal/min, chrome reduction of rinse waters was estimated to cost $9,000 annually. This figure is based on operating and maintenance costs of $3-$4/1000 gallons treated. Disposal of D007 waste (contains chromium) was about $1,600/year, based on a $400/drum transportation and disposal fee. Historical data showed the average chromate bath life to be six months. ***Pollution Prevention Process*** There were no reductions in treatment of rinse waters, no hazardous air pollutants (HAPs) and no hazardous waste products. ***Common to Both Processes*** Wastewater treatment of rinsewaters for heavy metal removal through precipitation was employed.
Economics	**Capital Costs** No capital costs were associated with this project. **Operating Costs** Operational costs for the "Alodine 2000" bath are estimated to be $0.04-$0.05/mg/1000ft^2 with a 50 mg/ft^2 target weight. This compares to a $0.03-$0.04/mg/1000ft^2 cost of a chromate bath with a 70 mg/ft^2 target weight. Based on coating requirements, this translates to a 12 percent cost advantage at the OMC-Milwaukee facility. **Payback Period** Immediate
Benefits	The facility benefited from: reduction of hazardous air pollutants; reductions in heavy metal loading in wastewater discharges; and the elimination of chrome bearing (D007) hazardous wastes.
Problems Encountered	In January, 1994, no commercial installation of the "Alodine 2000" process for the conversion coating of aluminum existed. OMC-Milwaukee decided to become the pilot plant and place strict testing criteria on production process and parts for the first year. With completion of the first year's production, no quality problems have surfaced with the parts or the process.
Technology Transfer	The product was originally formulated by the Boeing Aerospace Company but was licensed to Parker-Amchem where development of the product and the total process package continued until it was suitable for general commercial use. "Alodine 2000" conversion coatings on aluminum is a technology that is easily transferable to many industries that use a chromate conversion system. It requires little or no modification to existing equipment.
Company Address	Outboard Marine Corporation (OMC) Milwaukee 6101 North 64th Street

	Milwaukee, WI 53218-1562 414/438-5097
Industry Contact	Mr. Jim Bonifield, Division Metallurgist 414/438-5126
Pollution Prevention Resources	**Free, On-site Technical Assistance** University of Wisconsin Extension Solid and Hazardous Waste Education Center Milwaukee area: 414/475-2845 Remainder of state: 608/262-0385 **Pollution Prevention Information Clearinghouse** Wisconsin Department of Natural Resources Cooperative Environmental Assistance 608/267-9700 or e-mail: cea@dnr.state.wi.us

Bureau of Cooperative Environmental Assistance
Wisconsin Department of Natural Resources
P.O. Box 7921
Madison, WI 53707
608/267-9700

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