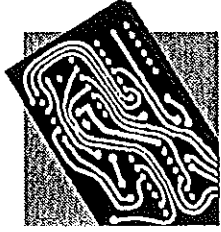


Examples of closed loop zero discharge manufacturing

Closed loop zero discharge manufacturing strategies have emerged as water pollution and excessive water usage by the high-tech industry have caused environmental damage in Silicon Valley and throughout the Southwest.

Attached are several recent examples of how some companies have already implemented closed loop systems in their manufacturing processes.

July '96



Closed-Loop Water Recycling

*For Printed Circuit Board Manufacturers
and Related Industries*

AGENDA

June 19, 1997

- | | |
|---------------|---|
| 11:30 - 12:00 | Registration, Lunch, and Welcoming Remarks
Rob D'Arcy, Santa Clara County Pollution Program |
| 12:00 - 1:00 | Rinsing Efficiency Techniques
Mass Transfer Calculations
Review of Available Technologies
Ken Ravon, Lee Engineering Enterprises International |
| 1:00 - 1:20 | Etchant Recycling, Liquid Ion Exchange
Tom Rogotzke, Silicon Valley Printed Circuits. |
| 1:20 - 2:10 | Sizing and Understanding Ion Exchange
Juzer Jangbarwala, Hydromatix, Inc. |
| 2:10 - 2:30 | Challenges, Problems, Benefits, and Maintenance of a Closed-Loop Operation
Gary Spencer, Gold Seal Plating |
| 2:30 - 3:00 | Questions, Answers, and Questionnaire |

BROUGHT TO YOU BY: SANTA CLARA COUNTY HAZARDOUS MATERIALS ADVISORY COMMITTEE'S
POLLUTION PREVENTION PROGRAM

IN COOPERATION WITH: LEE ENGINEERING ENTERPRISES INTERNATIONAL • BUSINESS ENVIRONMENTAL ASSISTANCE CENTER
• SURFACE TECHNOLOGY ASSOCIATION • PRINTED CIRCUIT ALLIANCE • LOCAL WATER POLLUTION CONTROL PLANTS

Regional Water Quality Control Plant

Operated by the City of Palo Alto
for the communities of East Palo Alto,
Los Altos, Los Altos Hills, Mountain View,
Palo Alto, and Stanford University



WASTEWATER RECYCLING AT WATKINS-JOHNSON COMPANY BUILDING 5

Watkins-Johnson's Building 5 wastewater treatment system began processing waste water in February 1994. In April 1996, Watkins-Johnson Company began to use the treatment system to recycle a large fraction of its process waters from its Building 5 semiconductor fabrication operations. Watkins-Johnson currently treats and reuses the wastewater generated from its gallium arsenide and thin-film operations. Installation of a wastewater treatment system to control pH levels and to reduce metals discharge to the sanitary sewer was required by a compliance agreement entered into with the Palo Alto Regional Water Quality Control Plant (RWQCP) in February 1992. Though not required to do so, Watkins-Johnson sought to eliminate its process-related sewer discharges through recycling of treated wastewater back into its semiconductor fabrication operations.

The operation employs approximately 60 persons. A full time operator is assigned to the on site wastewater treatment and recycling system.

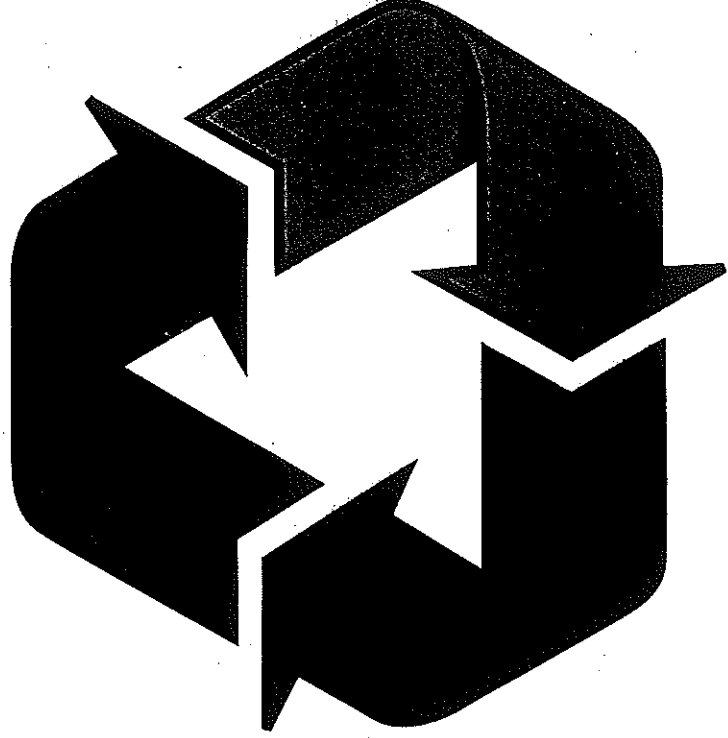
Waste-Generating Activities

Watkins-Johnson manufactures wafers for semiconductor applications. At the Watkins-Johnson fabrication facility gallium arsenide is cut into wafers that are used for various semiconductor products. The wafers are cleaned, masked, cut, etched and plated. Completed parts are used in semiconductor products.

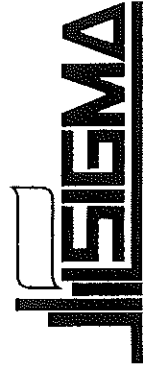
There are four wastewater streams generated within the facility. These wastewater streams consist of rinse water generated from etching operations, the concentrated acid and base wastewaters used in etching, and the gallium arsenide wafer saw wastewater.

The rinse water and concentrated acid and base wastewaters are generated by processes that involve immersing gallium arsenide wafers in beakers containing acidic or basic solutions to etch, strip, or clean them. After the concentrated acid and base solutions are used they are aspirated from the beakers and the beakers are triple-rinsed with recycled water that is aspirated as well. Rinse waters are discharged to additional designated lift stations.

MECER



**CLOSED LOOP RECYCLING
OF ALKALINE ETCHANTS**



CLOSED LOOP ZERO DISCHARGE

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IT'S ECONOMICS

06/17/97

Lee Engineering Enterprises International

Purpose of the workshop

- Enhance Collaboration Between Industry, Engineers/Consultants, and the Vendors.
- Introduce Basic Recycling Requirements & Technologies
- Present Technology of Recycling Approach & Alternatives
- Partnership Approach

06/17/97

Lee Engineering Enterprises International