Water Conservation in the Semiconductor Industry

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Global Facilities Engineering Manager
• Provide comprehensive portfolio of energy efficient solutions
• Help customers solve their unique design challenges
• Empower design engineers to reduce global energy use
• Operate a responsive, reliable world-class supply chain and quality program
• Maintain global environmental sustainability and social responsibility programs
• Headquartered in Phoenix, AZ
• Numerous design centers around the globe
• 22,000 employees worldwide
• 17 Manufacturing Sites around the world
• 2014 Revenue of $3.162 billion
Two types of manufacturing facilities
- Wafer Fabs
- Assembly Test Factories

Main Uses of Water
- HVAC
- Process
Products from the Factories

Wafer Fab Products

Assembly Test Products
HVAC Water Use

• HVAC intensive industry
• Required for maintaining process stability and comfort
• Largest user is cooling towers
  – Blow down goes to drain
Process Water

• Reverse Osmosis/Deionized Water (RODI)
• City Water
With and Without Manufacturing

• 2010 we used 120 million gallons of water
• Factory closed in 2011, with cleanup going into 2012
• 2013 the site was substantially stable and used 28 million gallons of water
• So the factory used 77% of our water in the process
Projects from Around the Globe

- Maximize water to abatement devices
- Change water types to point of use abatement
- Process Improvements/Tool idle flows
- RO reject usage
- Rinse water reuse
• Process Acid Hoods have multiple tanks
• There may be one or more rinse tanks for cleaning the residual acids off the wafers
• The rinse water will contain small quantities of acid, but generally be highly dilute
• So rinse water has a high potential of being reused
Where can we use it

• HVAC Systems
  – Cooling Tower Make Up Water
  – Boiler Make Up Water
  – Air Abatement Devices

• Process
  – Make Up Water for the DI System
Pros and Cons for Use

• HVAC
  – Water is very clean so little treatment may be needed
  – May be corrosive depending on system

• Process
  – Concern about introducing contaminant(s) into system
  – Very clean and reduces DI manufacturing chemical usage
What we decided

• Initially send water to air abatement systems (scrubbers)
• Collect data and make provisions for using it for make up to the DI system
• Install new drain system
  – Challenging given the current conditions of the building

• Hook up tools to new drain system
  – Needed to work closely with manufacturing to modify their tools

• Build new treatment system
  – Had to be fool proof
Hood can have multiple baths
Older hoods had a single plenum for all waste
Needed to add weirs and drains
Scheduling with 24x7 manufacturing was difficult
• Designed to minimize risk to operations
• Involved two tanks for water storage and two chemical totes
• Monitored pH, TOC, and TDS
Treatment Process

- Water would gravity feed into the main treatment tank
- Tank constantly agitated with a mixer
- 50% NaOH would be metered into this tank to adjust pH to a value of 7 to 8
- Water then overflowed to a large storage tank
- When storage tank was full, then the system would pump to the abatement system make up
When there were problems

• If the system detected a problem with pH, TOC, or TDS, then the flow would divert to our industrial waste treatment plant

• We also changed to 20% NaOH after the initial start up
How we did

• Eventually, we were able to sustain about 45gpm from the factory, saving approximately 24 million gallon per year
• Sent to the abatement scrubbers to supplement city water make up
• Eventually redirected to the incoming make up water for DI