PRAB

Industrial Wastewater & Zero Liquid Discharge

Feasibility Study

A framework for evaluating wastewater treatment and ZLD investment, illustrated with two documented PRAB installations.

70-90%	100%	8 Mo.
Distillate Recovery	Water Reuse (ZLD)	Fastest Documented Payback

Prepared by PRAB, Inc. | Kalamazoo, Michigan | prab.com

Why This Feasibility Study Exists

Manufacturers evaluating industrial wastewater treatment or Zero Liquid Discharge (ZLD) rarely start with a clear picture of what results are actually achievable. This document combines PRAB's standard feasibility framework with two documented equipment installations, so you can compare your own wastewater profile against real, verified outcomes before committing capital.

Quick Answer

A wastewater or ZLD feasibility study evaluates your wastewater composition, flow rate, and disposal costs against available treatment technologies (ultrafiltration, reverse osmosis, vacuum evaporation, automated pH adjustment) to determine achievable volume reduction, water reuse, and payback period. PRAB's documented installations show distillate recovery rates of 70% to 100% and paybacks as fast as eight months, depending on wastewater chemistry and flow.

How to Use This Study

Read the feasibility framework on the next page to understand the questions that determine whether ultrafiltration, reverse osmosis, pH adjustment, or vacuum evaporation is the right fit for your facility. Then review the two case studies that follow. Both involve PRAB EVALED® Vacuum Evaporators solving high-strength wastewater problems in demanding industries, with full before-and-after treatment data.

The PRAB Feasibility Framework

Every PRAB wastewater project begins the same way: with an analysis of the wastewater itself, not a piece of equipment. The framework below outlines the questions that determine which treatment technologies apply to your facility and what results are realistic.

1. Characterize the Wastewater
What is the source (rinse water, plating bath, cooling water, acid pickling, coolant)? What are the total dissolved solids (TDS), total suspended solids (TSS), pH, conductivity, and any regulated contaminants such as heavy metals or COD?

2. Establish Flow Rate and Volume
How many gallons or tons per day require treatment? Flow rate determines whether a batch or continuous-flow system is appropriate and directly sizes the treatment equipment.

3. Define the Goal
Is the objective regulatory discharge compliance, water reuse to reduce freshwater purchases, or Zero Liquid Discharge to eliminate hauling entirely? Each goal points toward a different combination of technologies.

4. Match Technology to Chemistry
Suspended solids and emulsified oils point to ultrafiltration. Dissolved salts point to reverse osmosis. High-strength or difficult-to-treat streams point to vacuum evaporation. pH adjustment applies almost universally as a compliance step.

5. Test Before You Buy
PRAB's FREE Fluid Testing, Materials Testing, and Demo Equipment programs validate real performance data on your actual wastewater before you commit capital, quantifying expected volume reduction, recovery rate, and payback.

6. Calculate Payback
Compare current hauling, disposal, and chemical costs against the documented reduction percentages for the proposed system. PRAB installations have achieved payback in as little as eight months and typically within 12 to 18 months.

The two case studies that follow show this framework applied to two very different, high-strength wastewater streams, both solved with PRAB EVALED® Vacuum Evaporators.

Case Study 1

Microelectronics Manufacturer Reduces Rinse Line Wastewater and Sludge

Industry: Microelectronics / TFT-LCD Panel Manufacturing | Technology: EVALED® Vacuum Evaporation

The Challenge

A top manufacturer of TFT-LCD panels needed to reduce sludge production and wastewater disposal costs at two of its plants, both generating wastewater from the rinse lines of a copper (Cu) etching production process, while complying with local environmental legislation.

The Solution

Because no two wastewater streams are exactly alike, PRAB conducted a careful review of each plant's process, along with testing and analysis of wastewater from each rinse line. A PRAB EVALED® Vacuum Evaporator was specified for each plant: a model RV F 15 AA at Plant 1, and two model RV F 30 AA units at Plant 2, one on each of two rinsing lines.

Plant 1 Treatment Results

Parameter	Unit	Waste In	Distilled Out	Concentrate Out
pH	-	6 - 6.5	9	-
TDS	ppm	4,000 - 50,000	< 10	-
Conductivity	uS/cm	< 8,000	< 30	-
Total Solids (105°C)	%	0.6 - 5	-	30
Chloride	ppm	< 500	< 300	-
Ammonium	ppm	500 - 5,000	< 500	-

Plant 2 Treatment Results

Parameter	Unit	Waste In	Distilled Out	Concentrate Out
pH	-	6 - 6.5	9	-
COD	ppm	80,000	< 4,000	-
Conductivity	uS/cm	< 50,000	< 20	-
Total Solids (105°C)	%	5 - 9	-	30
Chloride	ppm	< 500	< 300	-
Ammonium	ppm	5,000 - 15,000	< 500	-

Results

70-90% Distillate Recovered & Reused	**8 Months** System Payback	**2 Plants** Rinse Lines Treated

After installing PRAB EVALED® Vacuum Evaporators on the rinsing line processes, each plant saw a significant reduction in sludge and disposal costs. Between 70% and 90% of distillate is now recovered and reused in the production process, with system paybacks achieved within 8 months of installation.

Case Study 2

Battery Recycler Achieves Zero Liquid Discharge and Recovers 80% of Concentrate for Resale

Industry: Battery Recycling | Technology: EVALED® Vacuum Evaporation (ZLD)

The Challenge

A company recycling over 3,000,000 automotive battery units and producing more than 40,000 tons of lead annually needed to recover water and sodium sulfate (Na2SO4) from spent sulfuric acid generated during battery recycling, in order to cut disposal costs and generate additional revenue.

The Solution

Following testing and analysis of the wastewater, PRAB specified an EVALED® Vacuum Evaporator (model RV F 60 FF) to treat approximately 63.7 tons per day (12 GPM) of spent sulfuric acid wastewater. The system produces 39.5 tons per day of distillate, which is recycled back into the process, and 24.2 tons per day of concentrate. From the concentrate, saturated liquid is recirculated to the storage basin while the remaining sodium sulfate salt is sold as a by-product to a cement factory.

Treatment Results

Parameter	Unit	Waste In	Distilled Out	Concentrate Out
pH	-	6.5	6	-
Total Solids (105°C)	%	12	< 0.01	> 80
Conductivity	uS/cm	> 100,000	< 80	-
Sulfates	ppm	> 70,000	< 50	-
COD	ppm	95	< 60	-
Chlorides	ppm	48	13	-
Lead	ppm	1.3	< 1.0	-

Results

100%	80%+	Resold
Water Reuse (ZLD)	Sodium Sulfate Recovered	Concentrate to Cement Producer

The system achieved Zero Liquid Discharge, with 100% of process water reused and no liquid wastewater leaving the facility. Over 80% of the sodium sulfate content is recovered as a saleable by-product, turning a disposal cost into a secondary revenue stream while eliminating discharge risk entirely.

What These Case Studies Show

Both facilities faced high-strength wastewater that was expensive and difficult to treat through conventional discharge. In both cases, PRAB EVALED® Vacuum Evaporation was specified only after testing and analysis of the actual wastewater, and in both cases the result was a documented, quantified reduction in disposal cost and volume.

	Microelectronics / TFT-LCD	Battery Recycling
Wastewater Source	Copper etching rinse lines	Spent sulfuric acid
Technology	EVALED® RV F 15 AA / RV F 30 AA	EVALED® RV F 60 FF
Water Recovery	70% - 90% distillate reused	100% water reuse (ZLD)
By-Product Value	Reduced sludge volume	80%+ Na2SO4 sold to cement producer
Documented Payback	8 months	Not disclosed; disposal cost eliminated

Is Your Facility a ZLD or Wastewater Treatment Candidate?

- ☐ Wastewater hauling and disposal costs are a significant and growing operating expense
- ☐ Your wastewater contains heavy metals, high dissolved solids, or chemistry that is costly to discharge conventionally
- ☐ Local discharge permits are difficult to meet, or regulators are tightening limits
- ☐ You want to reduce freshwater purchases through on-site reuse
- ☐ A concentrated by-product in your wastewater (metals, salts) could be recovered and resold

Next Step

PRAB's FREE Fluid Testing, Materials Testing, and Demo Equipment programs validate real performance data on your actual wastewater, free of charge, before you invest in equipment. Request a free process water and wastewater analysis by contacting PRAB's water treatment specialists here, or call (800) 968-7722.

Written by Paul Montgomery, Marketing Leader at PRAB, Inc. Case study data sourced from PRAB Application Reviews: “Microelectronics Manufacturer Reduces Rinse Line Water Disposal Costs and Sludge with Vacuum Evaporation” and “Battery Recycler Achieves Zero Liquid Discharge (ZLD) and Recovers Over 80% of Concentrate for Resale,” both published at prab.com.