EISENMANN

Eisenmann Corporation

Environmental Technology

SEMARNAT - Sugar Industry 8th Meeting

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www.eisenmann.com

About Eisenmann

Eisenmann is a Leading Global Systems Integrator and Supplier of Surface Finishing Systems, Environmental Technology, Material Flow Automation and High Temperature Process Technology.

- Concept, Design and Construction Expertise
- Highly Flexible Systems Integrator
- Market and Technology Leader
- Service Provider

- Family-Owned Company
- Sound Financial Foundation
- Sustainable Economic Management
- Innovative High-Tech Company

Eisenmann Company Divisions

Automotive Systems

- Paint Shop Lines
- Body Shop Conveyors
- Final Assembly Lines

General Finishing

- Metal Painting
- Plastic Painting
- Final Assembly Conveyors

Environmental Technology

- Water Treatment
- Exhaust Air Treatment
- Waste Disposal & Waste to Energy
- Biogas & Biowaste
- Ammunition Disposal

Process & High Temperature Technology

- Coil Coating
- Special Atmospher Kilns
- Heat Treatment
- Carbon Fibre Turnkey Solutions

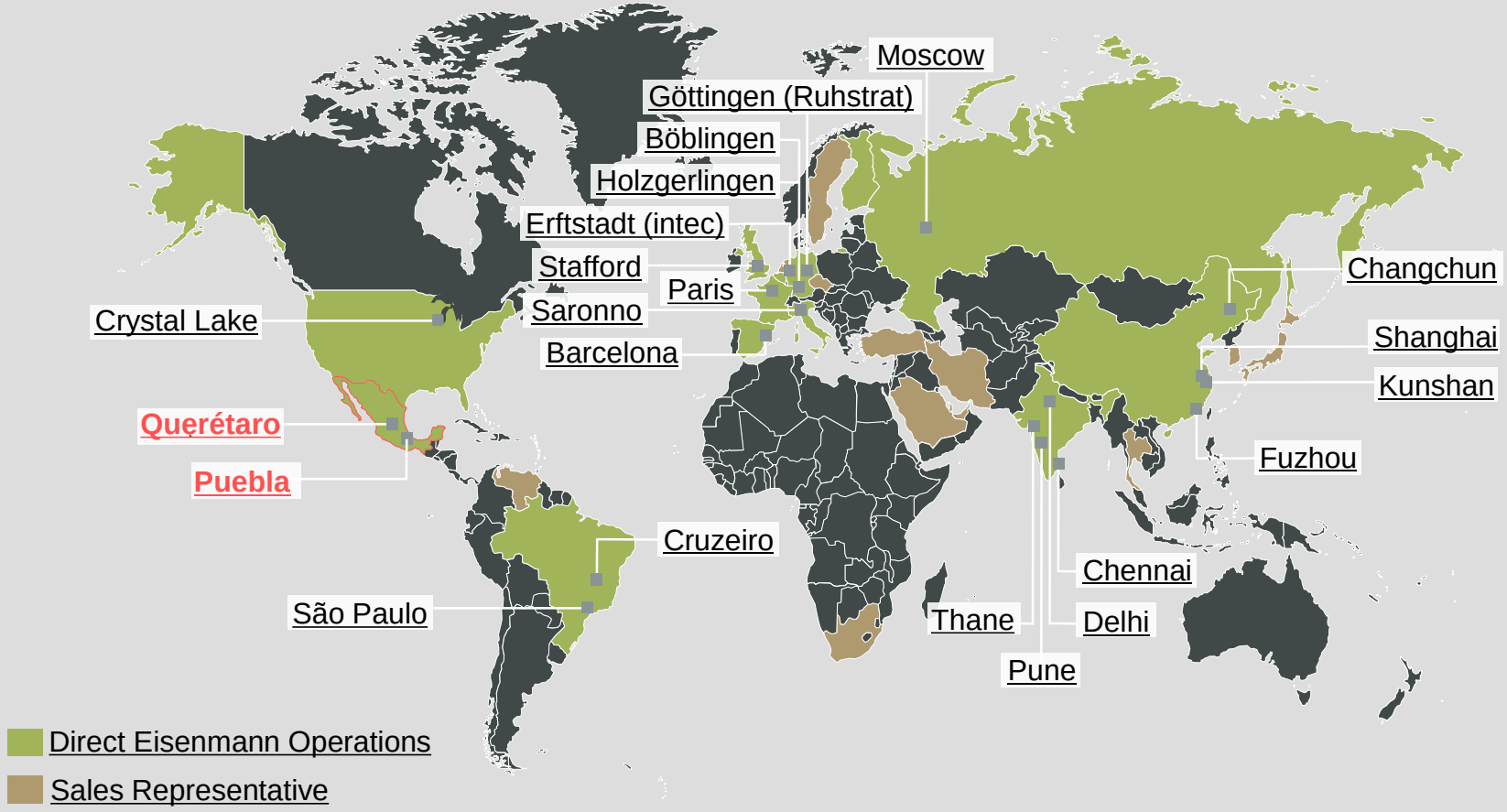
Conveyor Systems

- Electric Monorail System
- Electric Floor Track Systems
- Power & Free Conveyors
- Peripheral Conveyor Systems

Service

- Spare Parts
- Refurbishment
- Full-Service-Models
- BOT-Models

Locations Worldwide



Eisenmann Mexico

2,700 m²

4,100 m²

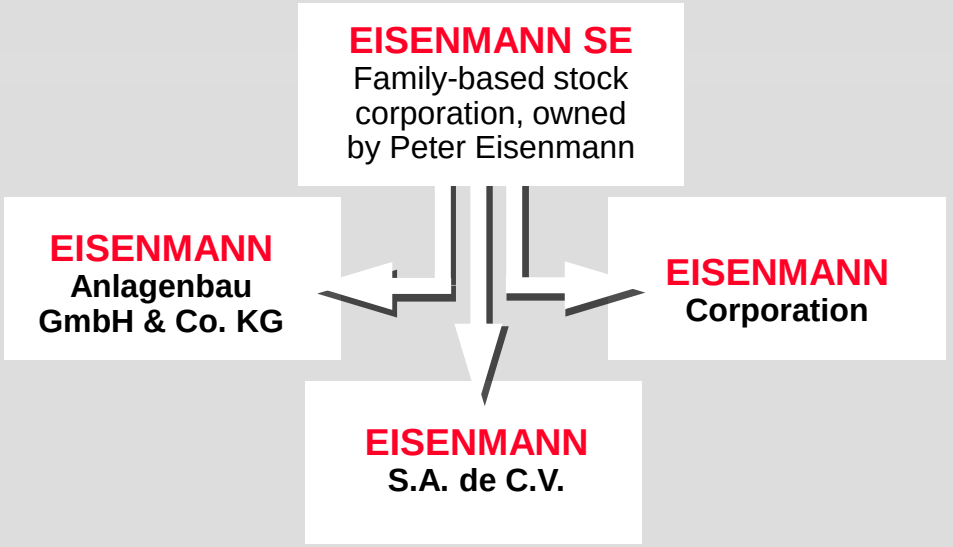
- Eisenmann Mexico founded 1994
- Puebla office and Queretaro production
- Built and supplied >100 plants
- Received “Supplier of the Year” award from VW in 2010
- Eisenmann S.A. de C.V. sales 2015: EUR 21 million

Key Financials

Key Financial Figures Eisenmann Group

	2013*	2014**	2015**
Turnover (in million €)	774.9	763.4	907.2
Order Intake (in million €)	791.0	836.0	1.020.0
EBT (in million €)	21.1	28.6	34.5
Equity (in million €)	204.9	201.7	205.5
Equity ratio (in %)	37.1	35.7	34.8

* accounted under German commercial code (HGB), ** accounted under IFRS



- Solid Financial Situation
- Sustainable and Successful Business Strategy
- Growing Share of Employees and Expertise
- Focus on Growing markets and Expansion of Global Added Value Chain

Development of Eisenmann Environmental Technology

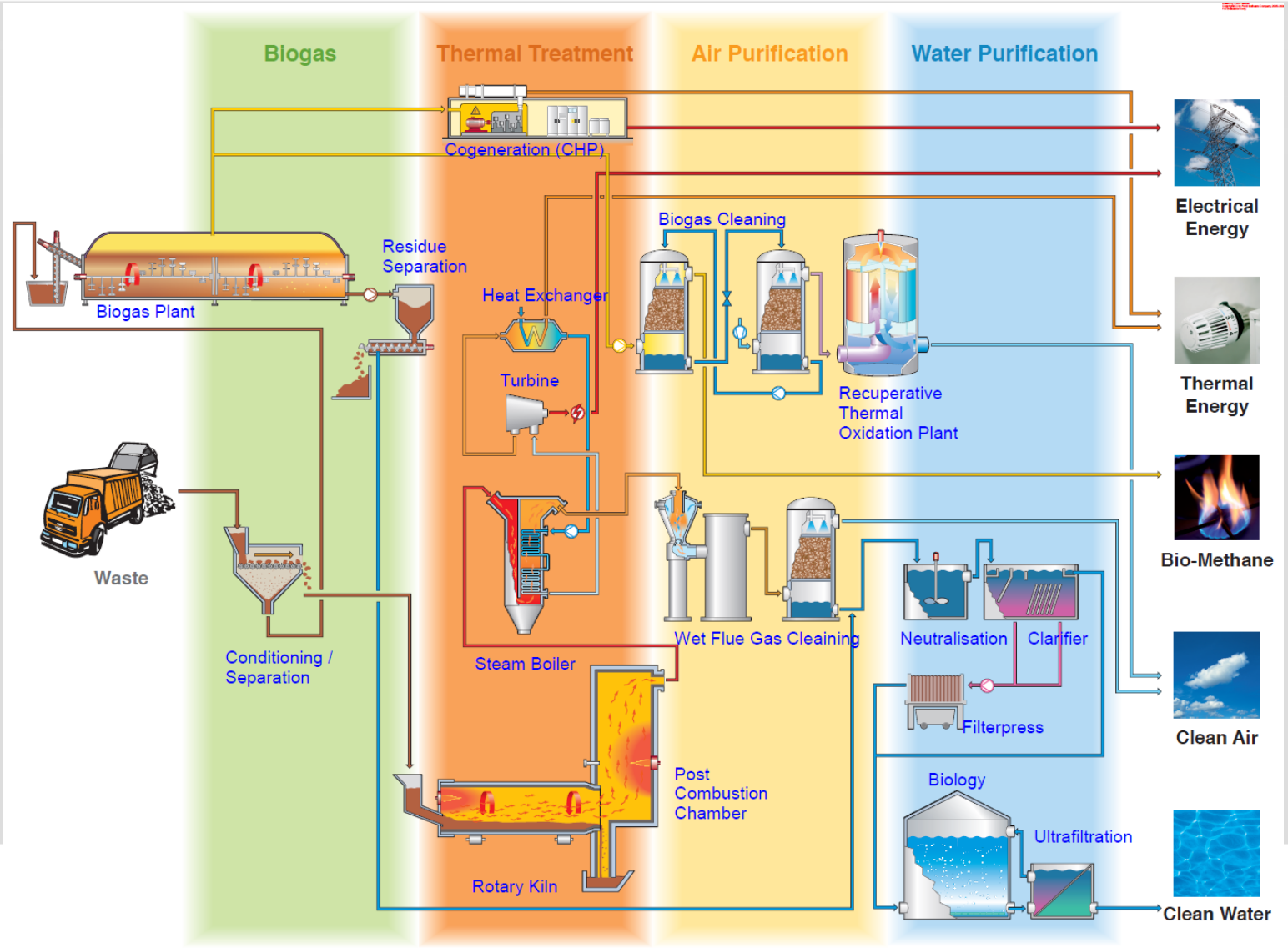
Highlights for Environmental Technology

- **1951** Founded in Stuttgart
- **1968** Thermal Oxidizer (1)
- **1970** Water Treatment Plant (2)
- **1987** Regenerative Thermal Oxidizer (3)
- **1989** Adsorption Wheel (4)
- **2001** Disposal Plant for Conventional Ammunition
- **2002** FENTOX® Waste Water Plant (5)
- **2003** Biogas NaWaRo plant (6)
- **2006** Disposal Plant for Chemical Weapons, Kambarka (7)
- **2007** Sewage Sludge Incineration with Pyrobustor (8)
- **2008** **Wet Electrostatic Precipitator (WESP)**
- **2009** Biogas from Municipal Waste Plant
- **2011** Anaerobic Digestion for Sewage Sludge
- **2012** Biogas Upgrading Plant
- **2013** Oil sludge Incineration with Fluidized Bed

- **2017** **50+ Years of Environmental Technology Experience and more than 2,500 plants installed worldwide**

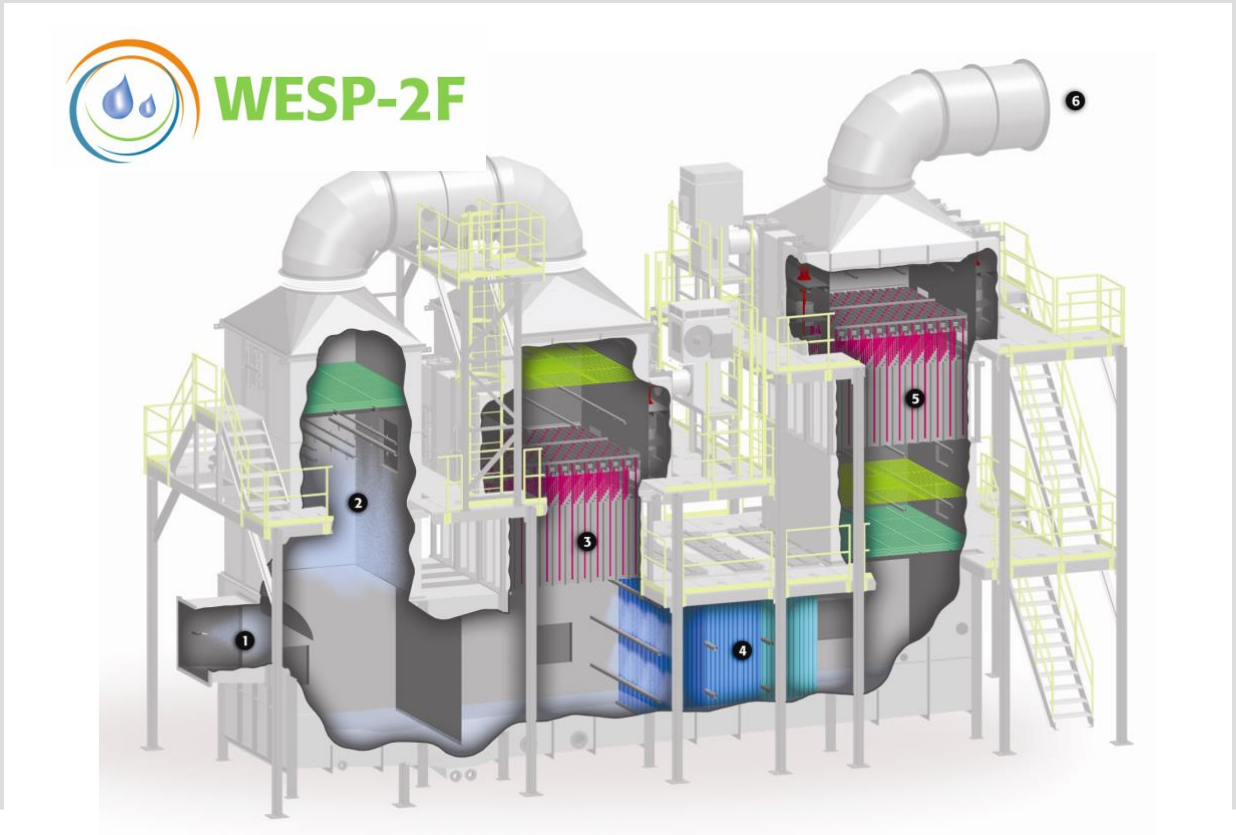
  25+ Years in Mexico and 40+ Years in USA

Environmental Technology - Summary



Exhaust Air Purification – WESP Technology

- **Multi-Pollutant Control**
- **Particulate Matter, Acid Gas, NOx**

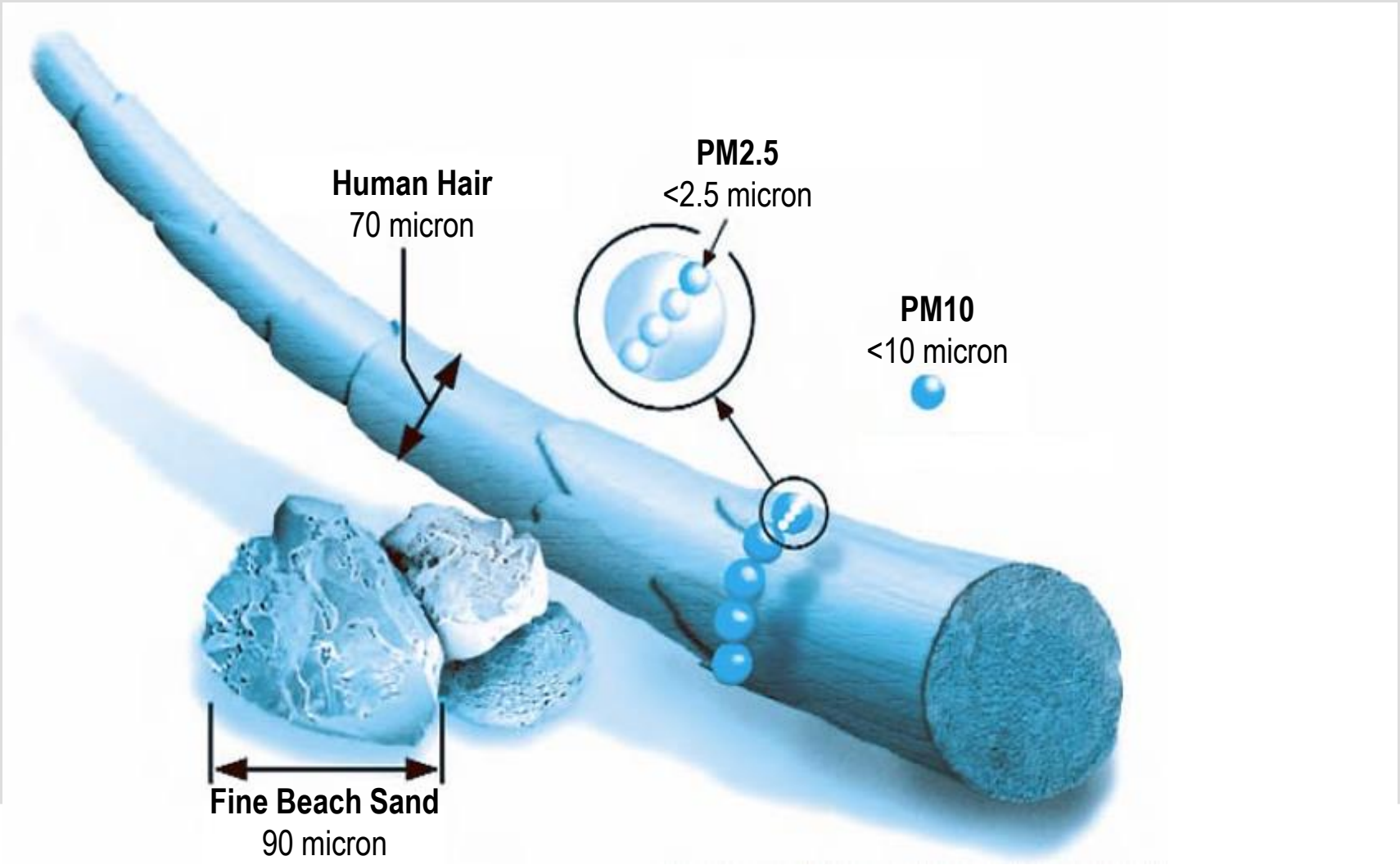


Multi-Pollutants

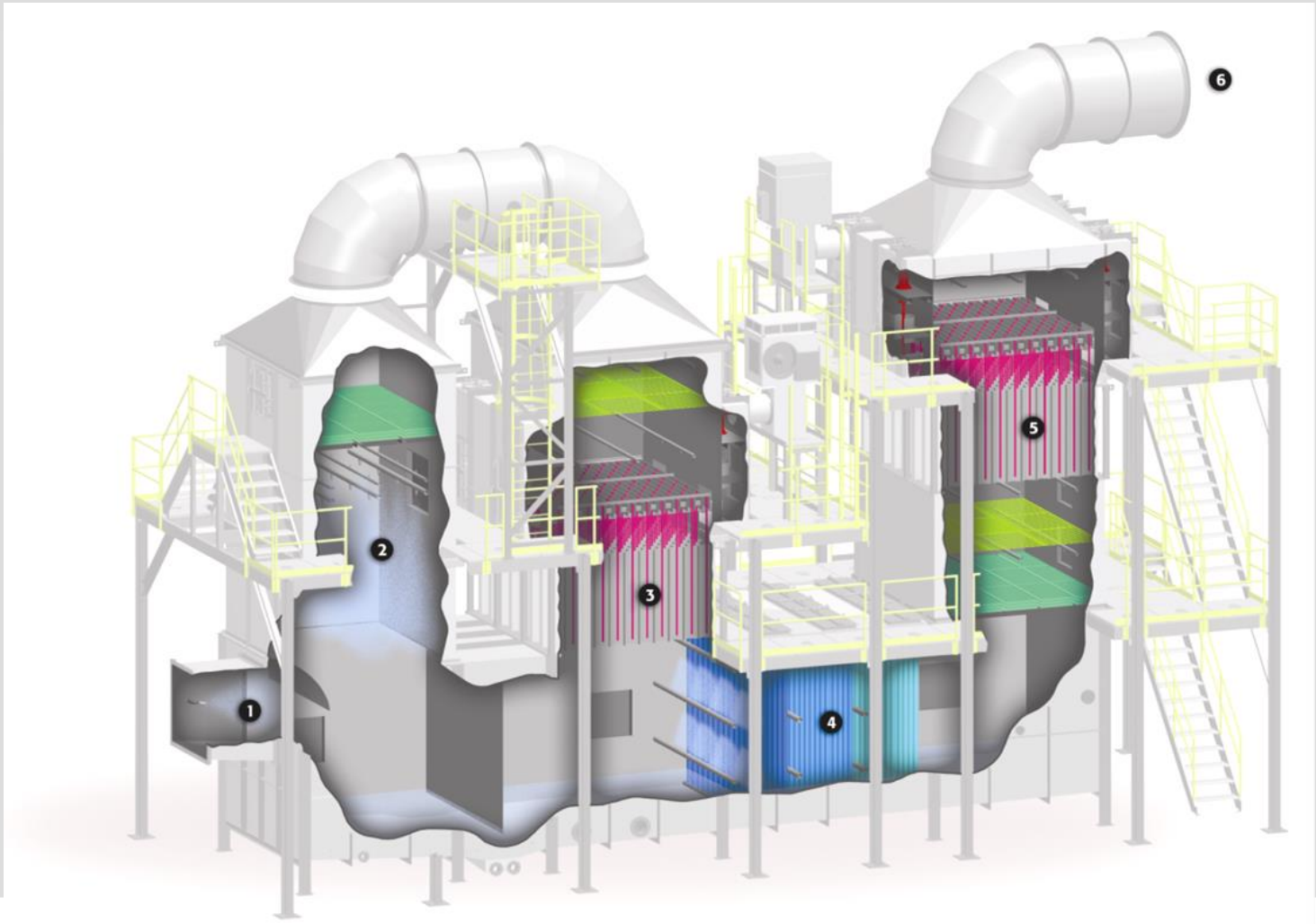
- Particulate Matter (PM, PM10, PM2.5)
- Acid Gases (HCl, HF)
- Oxides of Sulfur / SO_X (SO_2, SO_3/H_2SO_4)
- Oxides of Nitrogen / NO_X (NO, NO_2)
- Mercury (Hg, HgO, $HgCl_2$)
- Total Selected Metals / TSM (As, Be, Cd, Cr, Pb, Mn, Ni, Se)

  Typically PM <0.1 μm

Particulate Matter (PM)

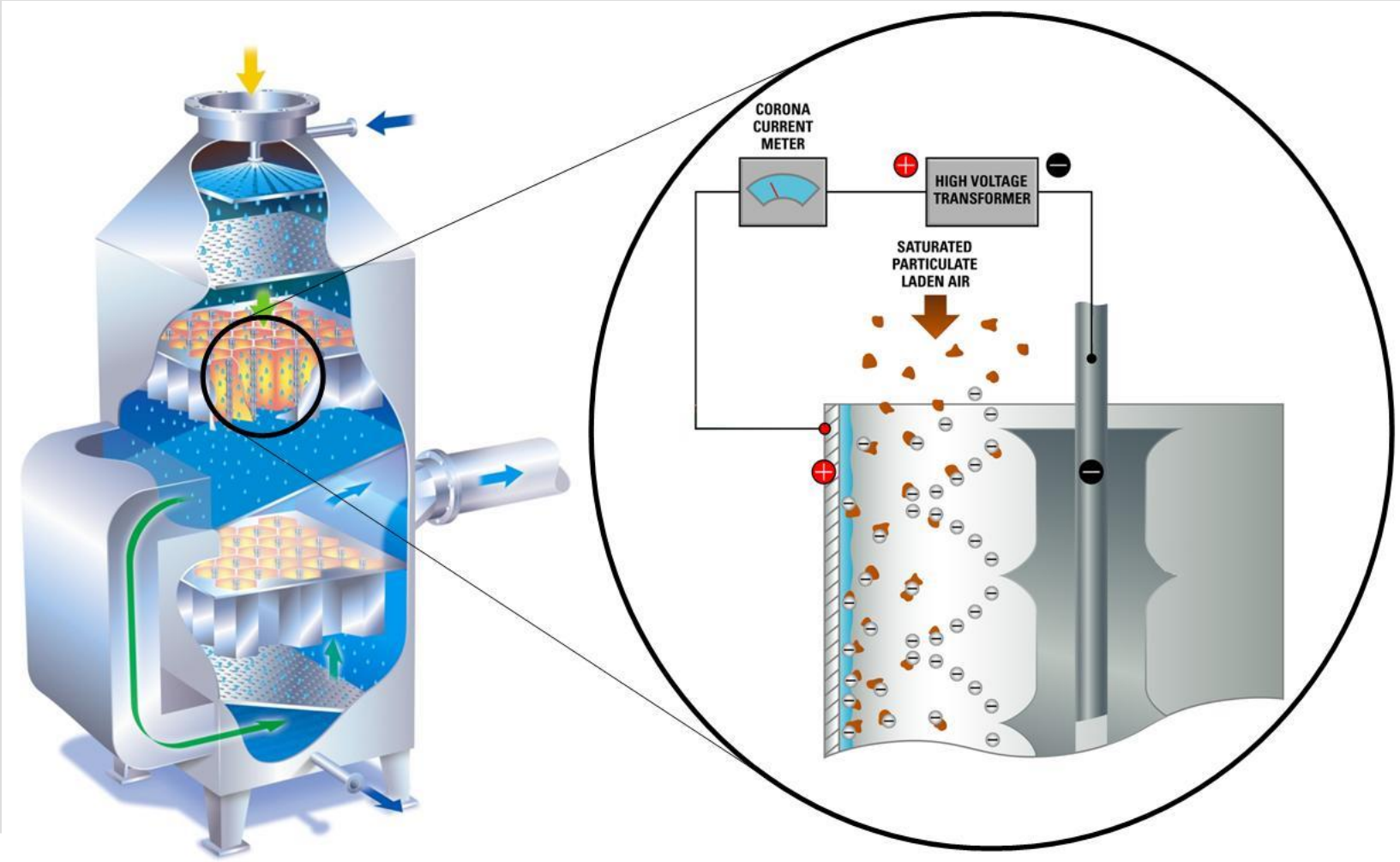


Eisenmann WESP-2F Technology (VIDEO)

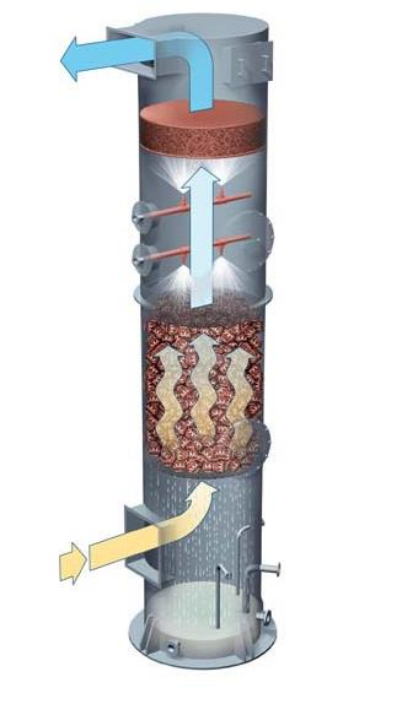


1. Quench
2. Spray Tower
3. Downflow WESP
4. NOx Scrubber
5. Upflow WESP
6. Exhaust Outlet

Basic WESP Operation

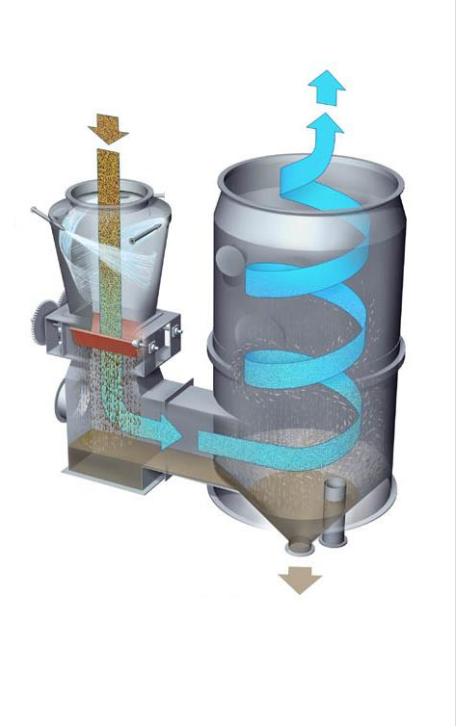


Traditional Control Technology Overview

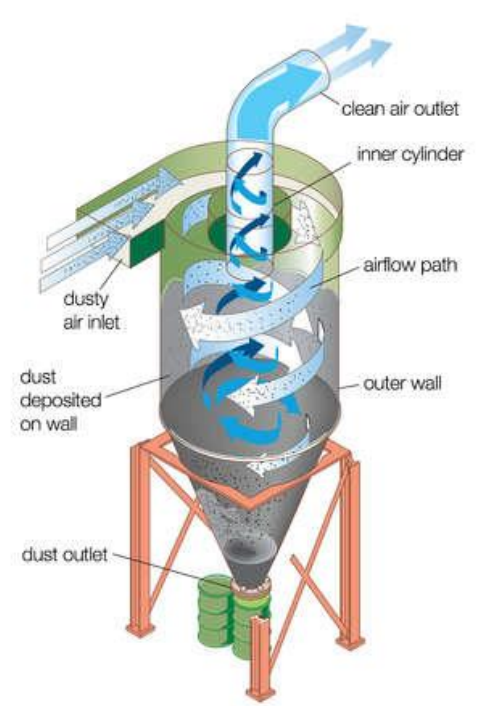


Packed Tower
Acid Gas Control

Fabric Filter
PM Control



Venturi Scrubber
PM, Acid Gas Control



Cyclone
PM Control

Dry vs. Wet Solutions

	Particle Type / Equipment	Acid Gas	Acid Mist	Hg	Moisture	PM10	PM2.5	Metals
Dry System	Cyclone					X		
Dry System	Fabric Filter					X	X	X
Dry System	Dry ESP					X		X
Wet System	Venturi Scrubber	X	X		X	X		
Wet System	WESP-2F	X	X	X	X	X	X	X

Performance Comparison

	PM Removal Efficiency (%)	Particle Size (micron)	Pressure Drop (”W.C.)
Cyclone	< 90%	> 5	2 - 8
Fabric Filter	< 99%	> 0.3	4 – 10
Venturi Scrubber	99% +	> 0.5	5 – 60
WESP-2F	99% +	> 0.01	0.5 – 4

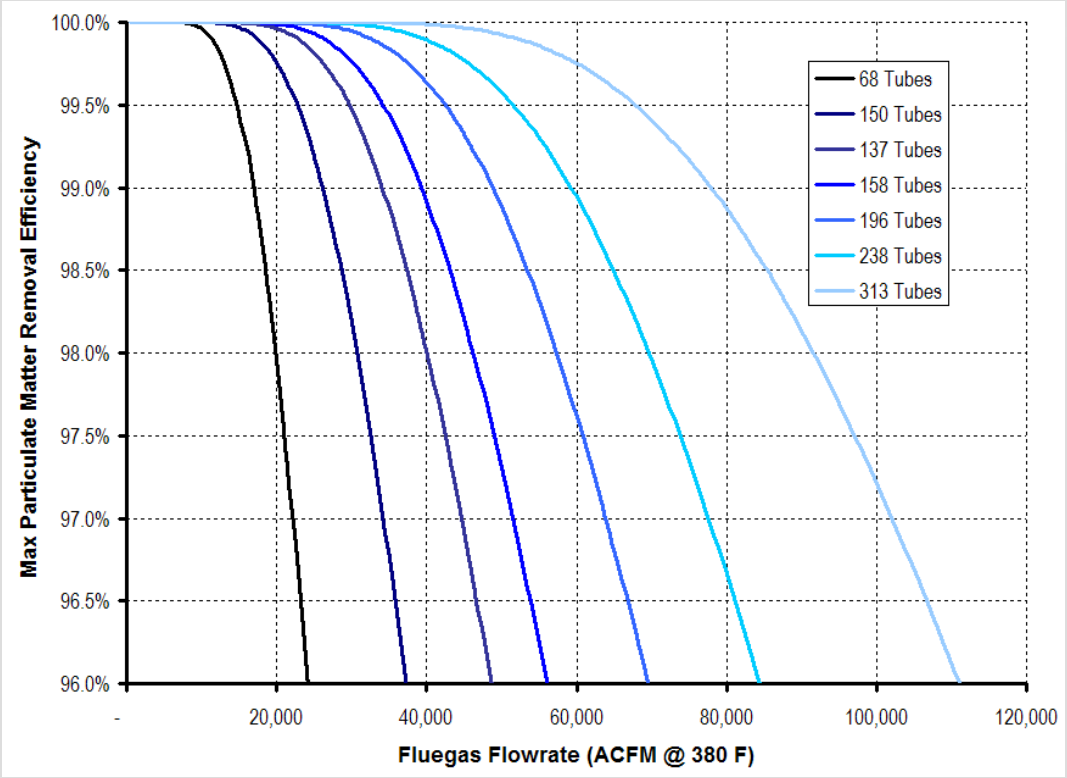
WESP-2F Solution for Medium Sized Power Boiler

Design Basis

- 500 MMBTU/hr (527 GJ/hr, 146 MW)
- Flue gas: 277,000 ACFM @ 380 deg F
- Humidity: 15% vol

System Configuration

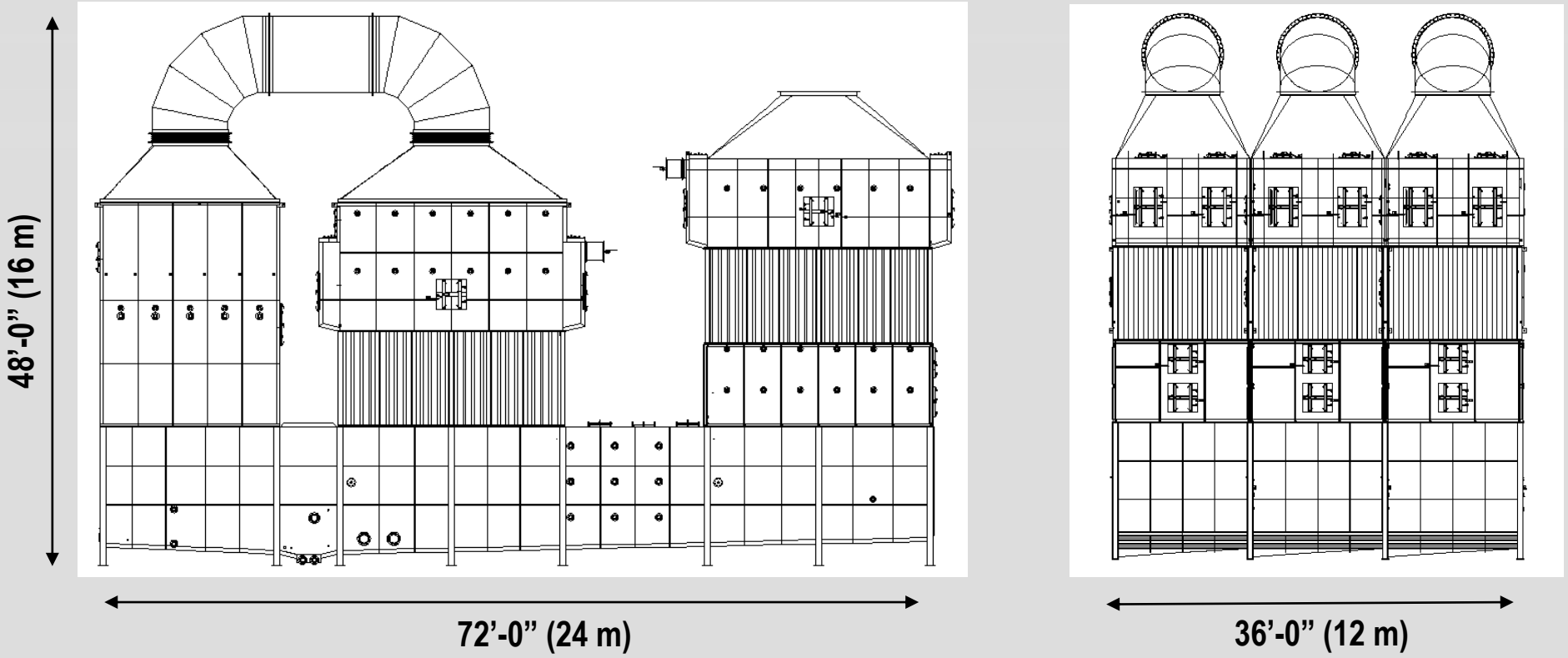
- 3x modular systems @ 313 Tubes
- One (1) Common Tank, Footprint, etc.
- Up to 200 GJ/hr per WESP-2F module



Sugar Mill Comparison

Small	< 100 GJ/hr	1 x modular system @ 158 tubes
Medium	100-200 GJ/hr	1 x modular system @ 238 or 313
Large	> 200 GJ/hr	> 2 x modular system @ 313

527 GJ/hr WESP-2F Design Solution



Sugar Mill Comparison

- Small 3 x 20 x 16
- Medium 4 x 24 x 16
- Large 8 x 24 x 16 and larger

WESP-2F Installation – 14 Days

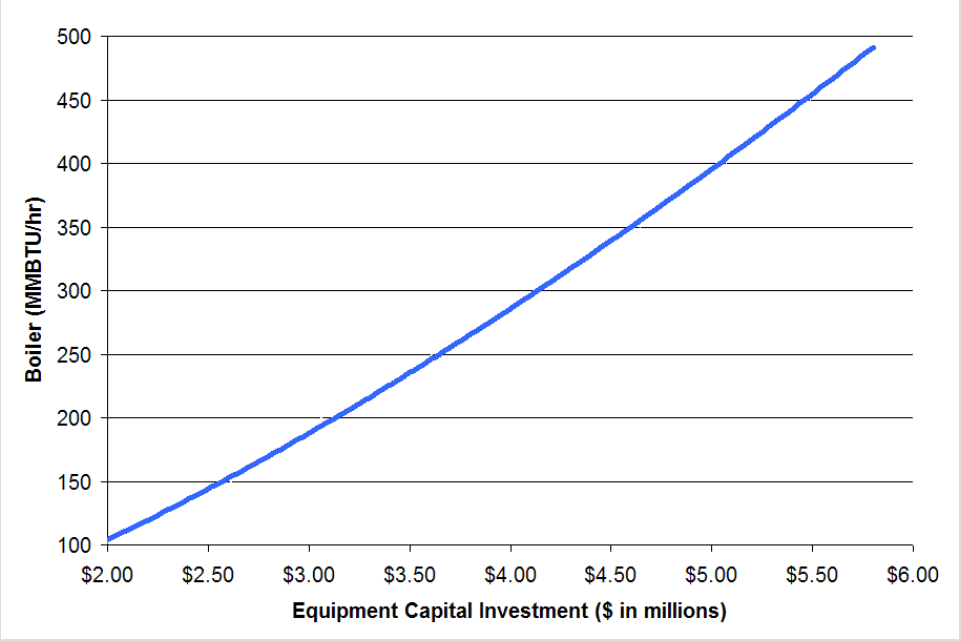
WESP Investment and Operation Economics

WESP Equipment Cost

- < 100 GJ/h $1,600,000
- 100-200 GJ/h $2,300,000
- >200 GJ/h $3,000,000 to $5,500,000

WWT Equipment Cost

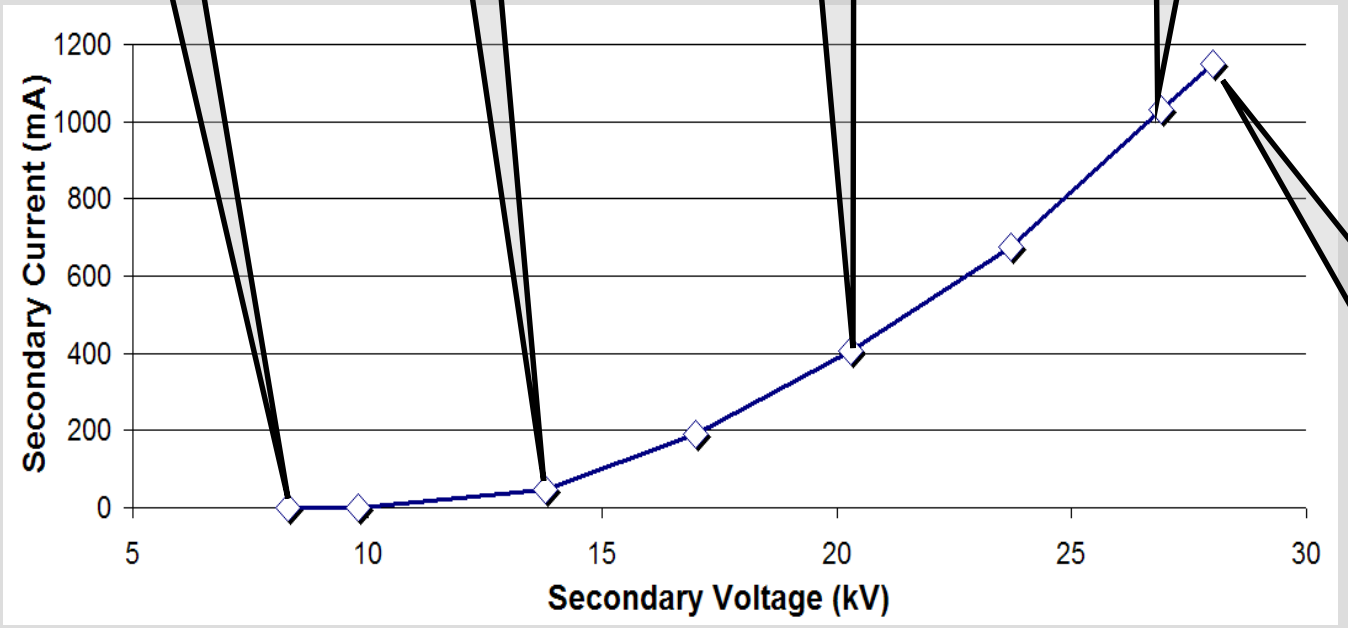
- Small $200,00 to $350,000
- Medium $350,000 to $550,000
- Large $500,00 to $1,000,000



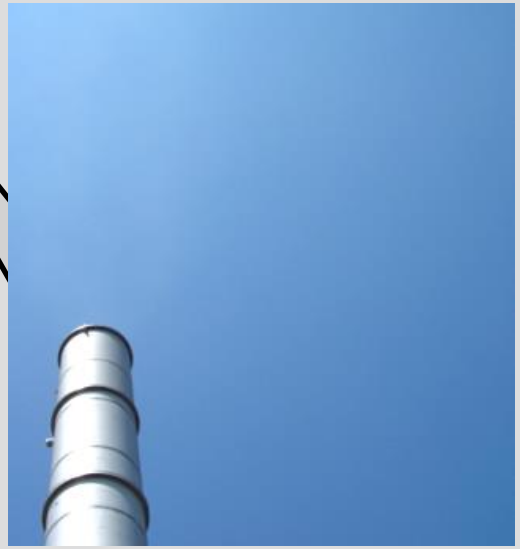
Utilities

- Water Intake < 0.6 LPM for each GJ/hr nameplate
- 480V / 3ph Power < 2.7 kW-hr for each GJ/hr nameplate
- Caustic (20% wt) ~ .02 LPM for each GJ/hr nameplate
- Bleedrate < 0.06 LPM for each GJ/h nameplate

WESP-2F Performance

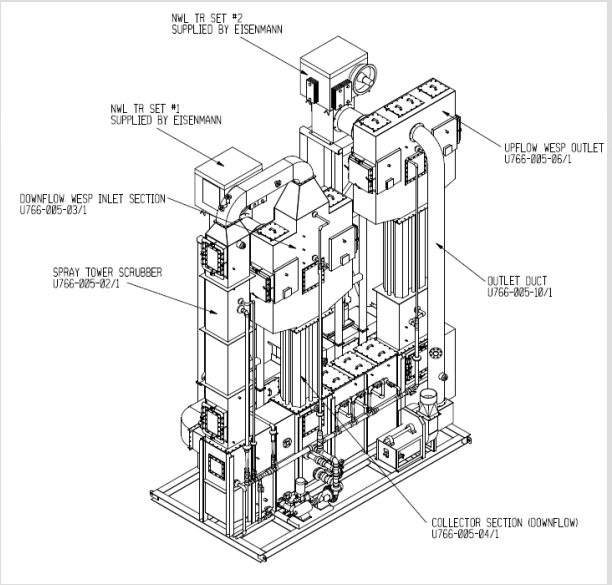


- PM, PM10, PM2.5 > 99%
- HCl, HF > 95%
- H_2SO_4 > 98%
- SO_2 > 95%
- Hg > 70%
- NO_x > 10%



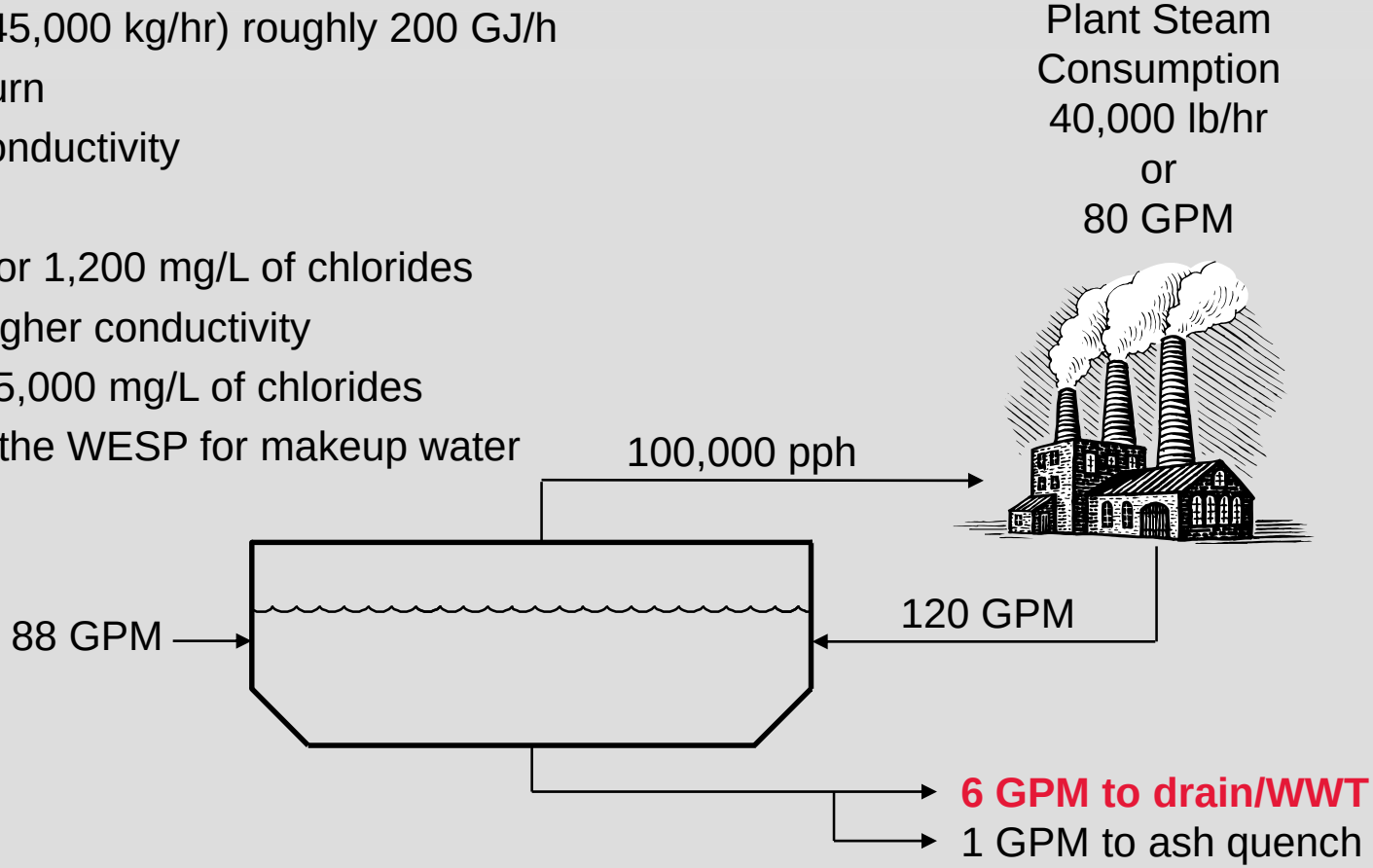
WESP-2F Pilot Unit (VIDEO)

- Proof of technology
- Available for on site testing since summer 2009
- Small footprint 9’-0” x 18’-0”
- Max flow ~ 1,000 ACFM
- Full WESP-2F capabilities
- Easy assembly (1-2 days)

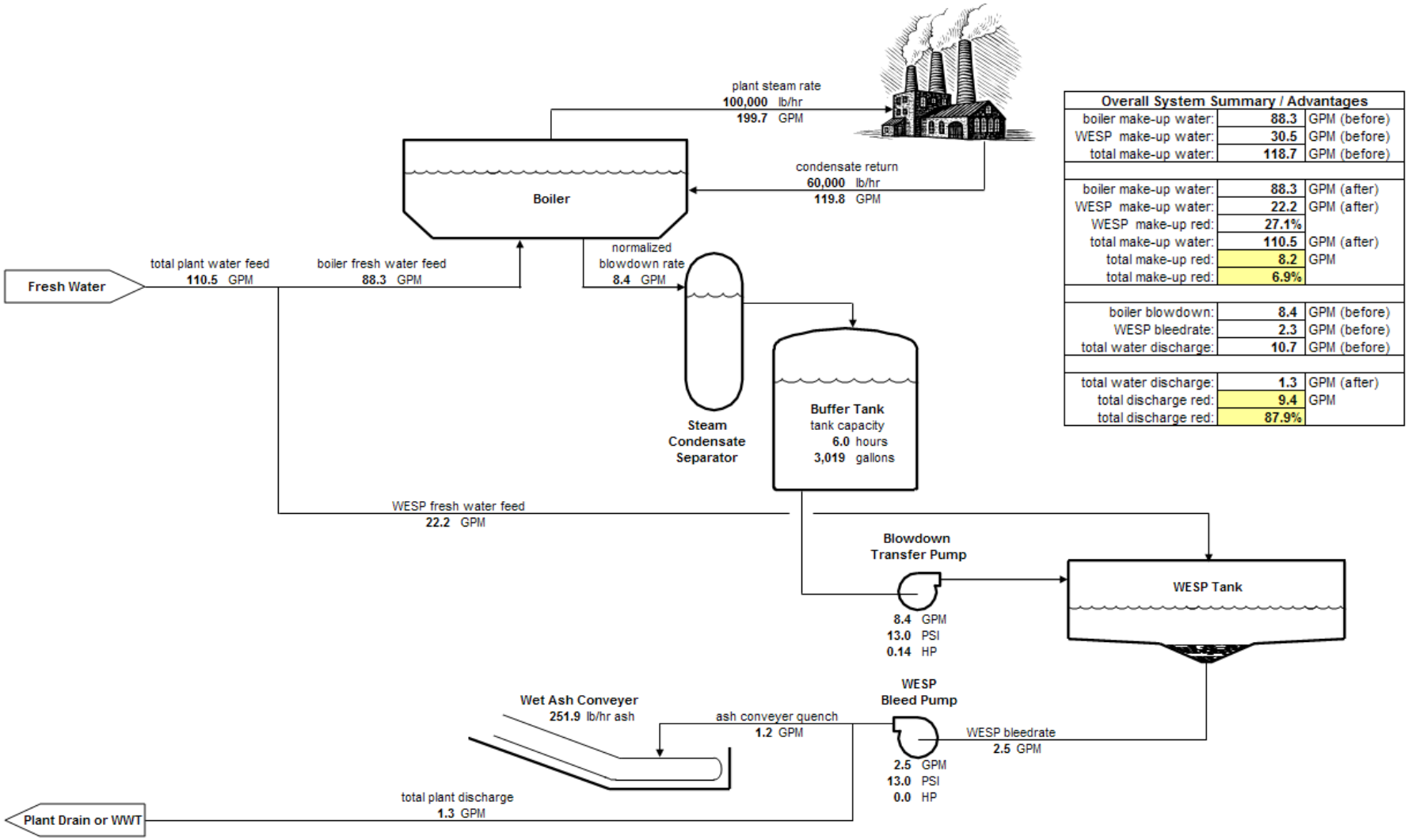


WESP in Plant Water System

- Example Operating Scenario:
  - 100,000 pph boiler (45,000 kg/hr) roughly 200 GJ/h
  - 60% condensate return
  - 4,000 mS/cm max conductivity
- Function of conductivity
- Initiated at 4,000 mS/cm or 1,200 mg/L of chlorides
- WESP can withstand a higher conductivity
- 316L SS can withstand ~5,000 mg/L of chlorides
- Send boiler blowdown to the WESP for makeup water



Boiler Blowdown Reduction



Overall System Summary / Advantages		
boiler make-up water:	88.3	GPM (before)
WESP make-up water:	30.5	GPM (before)
total make-up water:	118.7	GPM (before)
boiler make-up water:	88.3	GPM (after)
WESP make-up water:	22.2	GPM (after)
WESP make-up red:	27.1%	
total make-up water:	110.5	GPM (after)
total make-up red:	8.2	GPM
total make-up red:	6.9%	
boiler blowdown:	8.4	GPM (before)
WESP bleedrate:	2.3	GPM (before)
total water discharge:	10.7	GPM (before)
total water discharge:	1.3	GPM (after)
total discharge red:	9.4	GPM
total discharge red:	87.9%	

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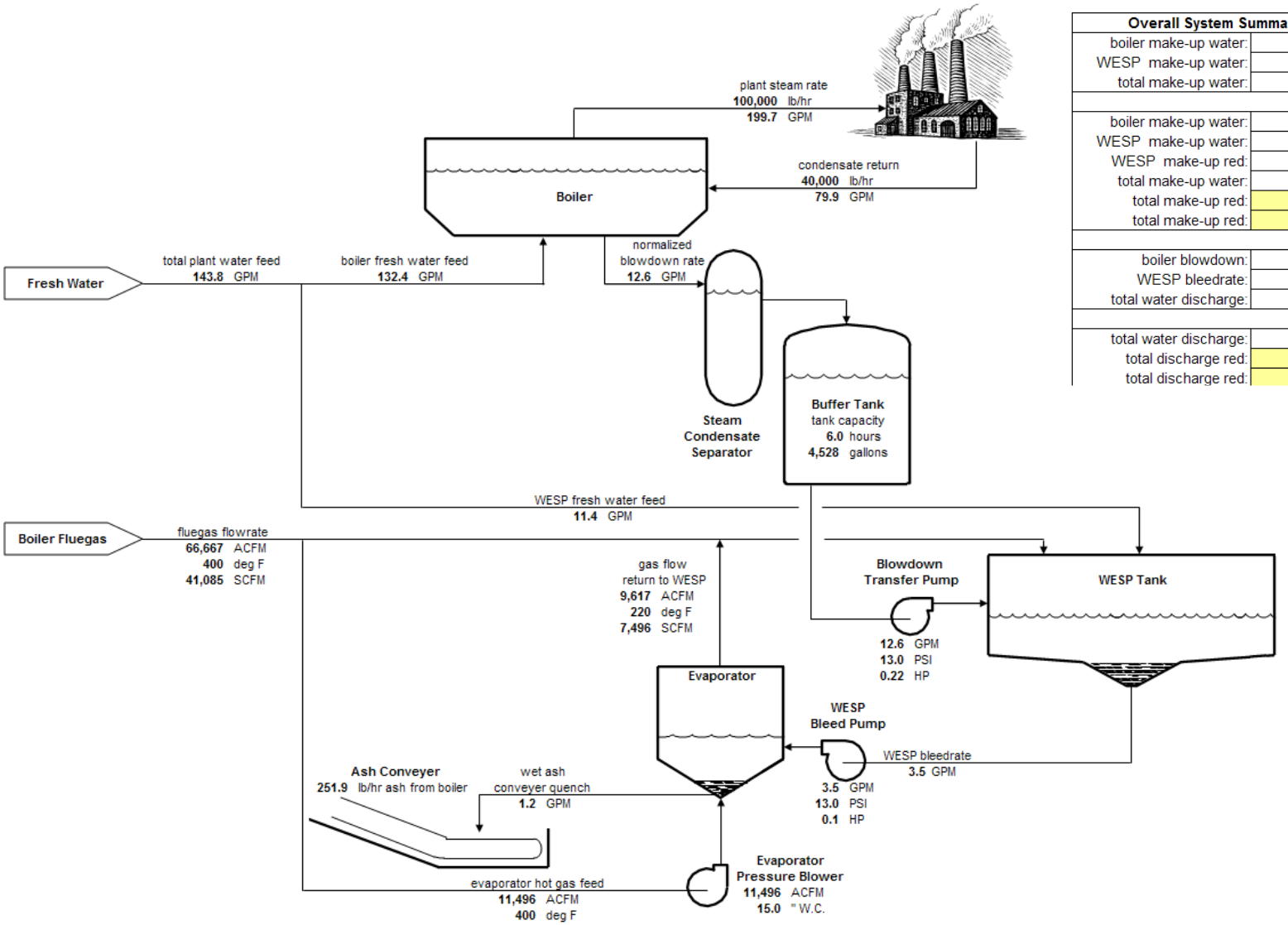
Boiler Blowdown Elimination



Overall System Summary / Advantages		
boiler make-up water:	132.4	GPM (before)
WESP make-up water:	25.1	GPM (before)
total make-up water:	157.5	GPM (before)
boiler make-up water:	132.4	GPM (after)
WESP make-up water:	11.4	GPM (after)
WESP make-up red:	54.7%	
total make-up water:	143.8	GPM (after)
total make-up red:	13.7	GPM
total make-up red:	8.7%	
boiler blowdown:	12.6	GPM (before)
WESP bleedrate:	2.3	GPM (before)
total water discharge:	14.9	GPM (before)
total water discharge:	-	GPM (after)
total discharge red:	14.9	GPM
total discharge red:	100.0%	

Experience - Freeport LNG

- $12,800,000,000 Plant Project
- Eisenmann Supplied Complete Air Emission Control System
- 3 x RTO plus WESP-2F Trains
- Fabrication in 2016, Delivery 2017
- Guaranteed Zero Visible Emissions

Summary

- Eisenmann long standing, stable and experienced company
- Worldwide presence and local support
- Domestic design, engineering, service and fabrication
- Proven reliable technology for PM, Acid Gas and NOx control
- Available pilot unit for individual plant test
- Eisenmann WESP is Best Available Control Technology (BACT)

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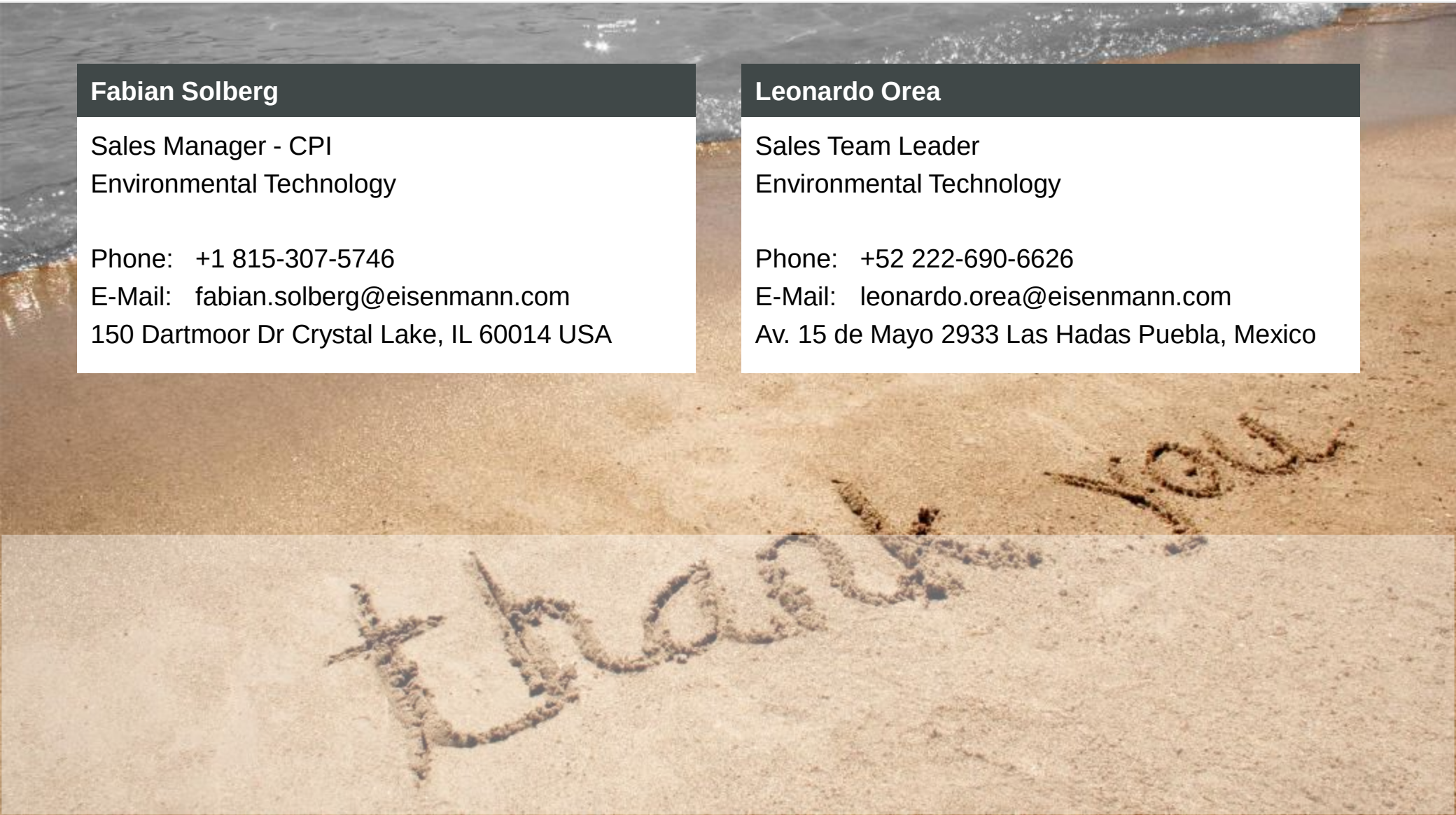

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