

The CoLD[®] Crystallization Process

HPD[®] Evaporation and Crystallization

McIlvaine Hot Topic Hour
August 15, 2013



Solutions & Technologies



Clean Technologies Innovation

Veolia Water Solutions & Technologies is Committed to Supporting our Customers to Achieve Their Sustainable Visions

Our integrated solutions include resource-efficient technologies to:

- Improve operations
- Reduce costs
- Achieve sustainability goals
- Decrease dependency on limited resources
- Comply with current and anticipated regulations

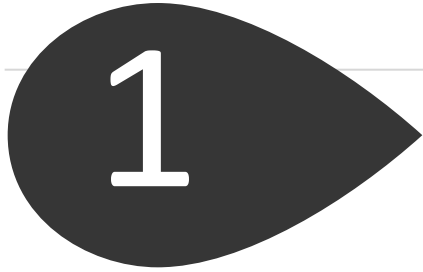


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Contents

- What is the CoLD Process?
- What are the advantages of CoLD Process?
- How is the CoLD Process applicable to FGD ZLD?
- Comparison of conventional FGD ZLD to CoLD ZLD.
 - Flowsheet
 - CAPEX
 - OPEX





What is the CoLD Process?

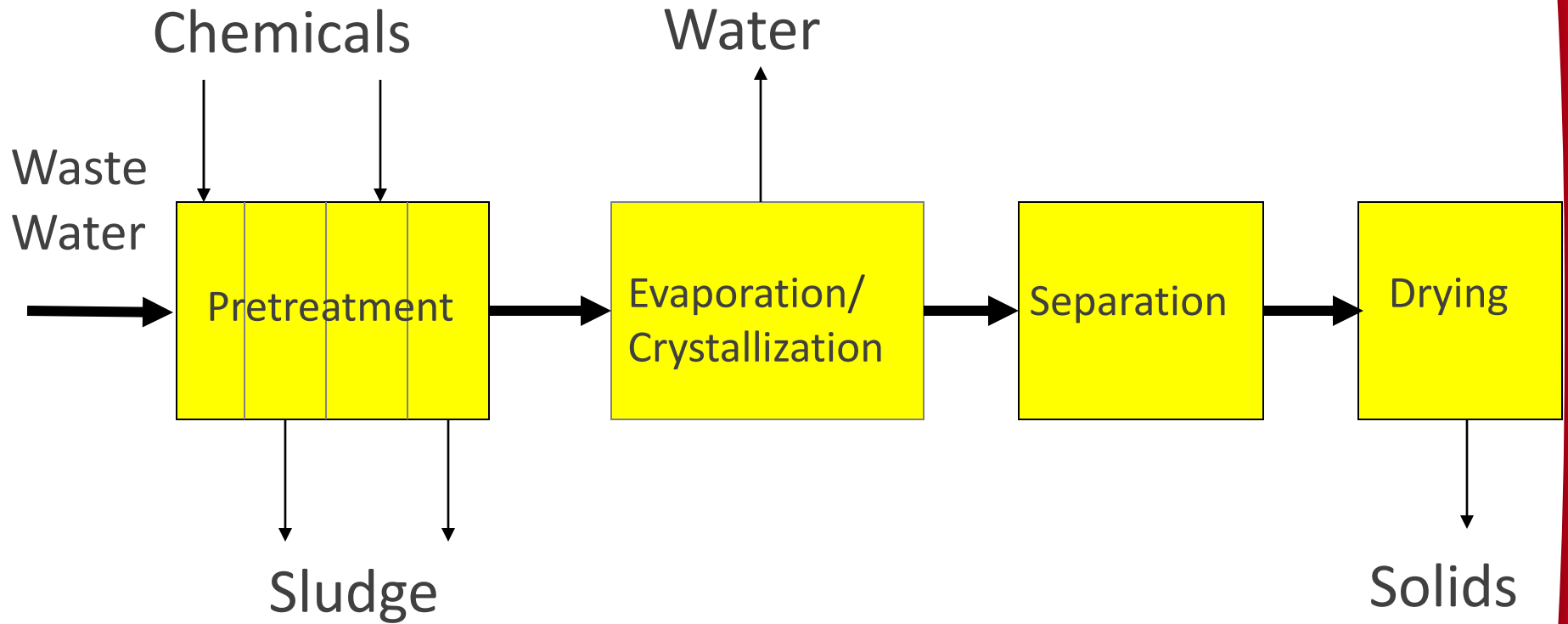


Crystallization
of high solubility salts at
Low Temperature and
Deep Vacuum

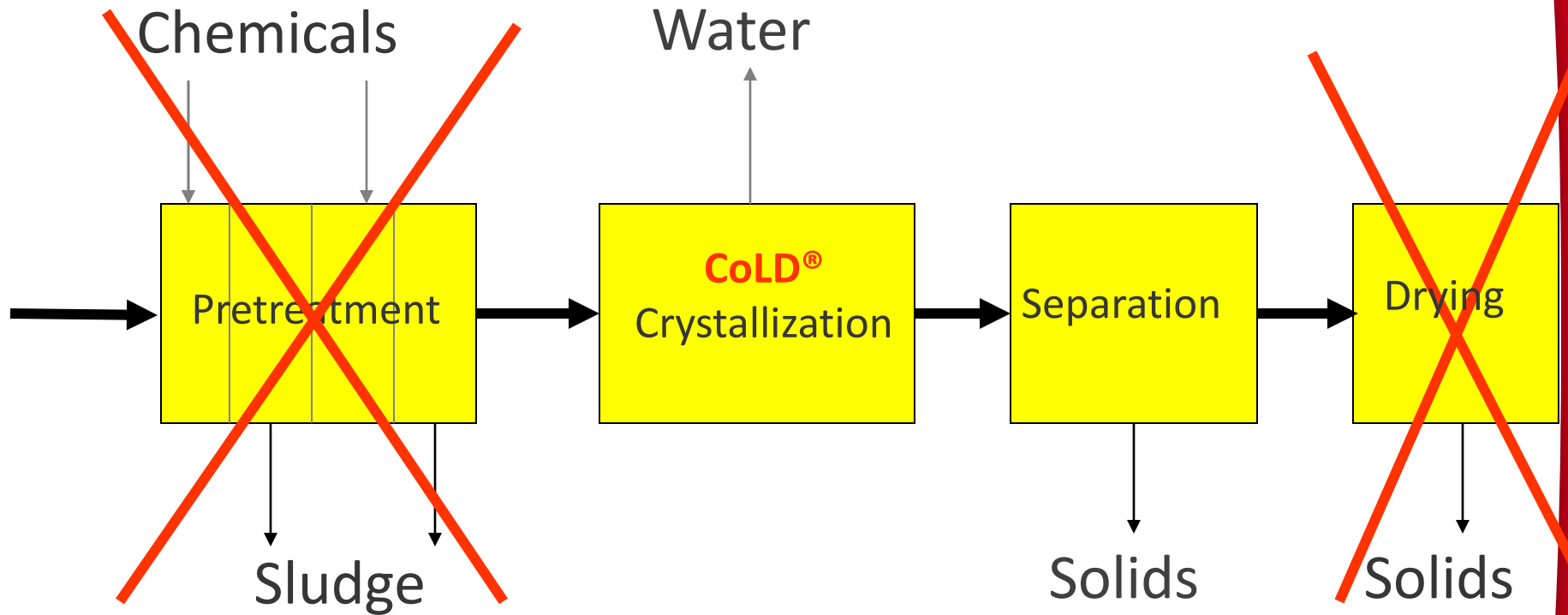
U.S. Patent 8,052,763



Conventional ZLD Process

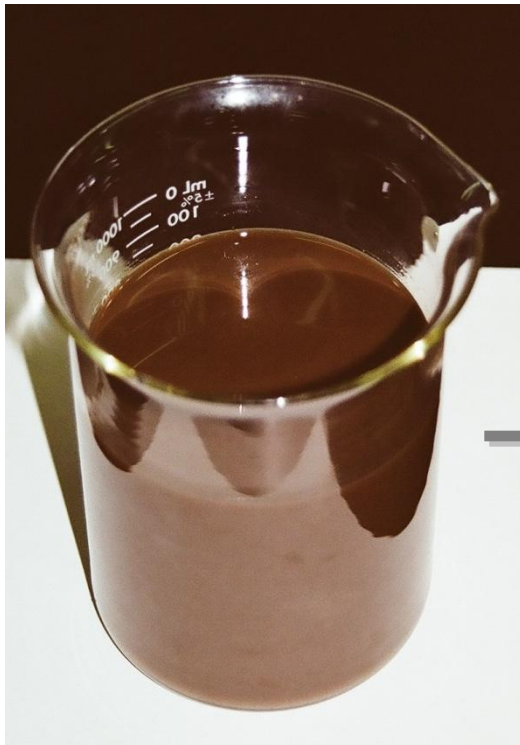


CoLD[®] Process



Result of CoLD[®] Process ZLD

FGD Scrubber Blowdown



Clean Water for Recycle and
Stable Solid for Landfill Disposal



2

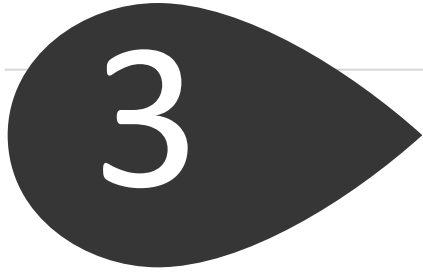
What are the advantages of CoLD Process?



Advantages of CoLD Process

- No Chemicals
- Much Less Solids to Dispose
- Simpler System with Fewer Unit Operations
- Robust System
- Similar Energy Requirement to Conventional Process
- Similar CAPEX
- Much lower OPEX





How is the CoLD Process applicable to FGD ZLD?

**Crystallization
of **high solubility salts** at
**Low Temperature and
Deep Vacuum****

U.S. Patent 8,052,763



High Solubility Salts Predominate in FGD Purge

- Chlorides
 - Calcium
 - Magnesium
- Nitrates
- Organic Acids
 - Formic acid
 - DBA





4

Comparison of conventional FGD ZLD to CoLD ZLD

Flowsheet

CAPEX

OPEX



Conventional ZLD for FGD

Monfalcone Power Plant, Italy

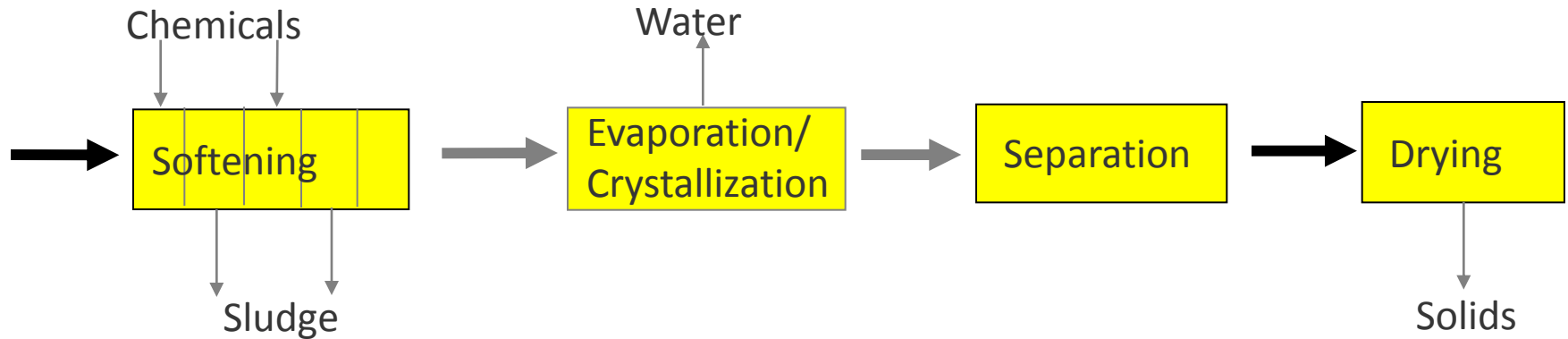
- ▶ 336 MW Coal-Fired
- ▶ LSFO Scrubber (MHI)
- ▶ ZLD Operational Summer 2008
- ▶ Dry Cake for Landfill Disposal

**Pretreatment:
Lime-Soda Ash
Softening**

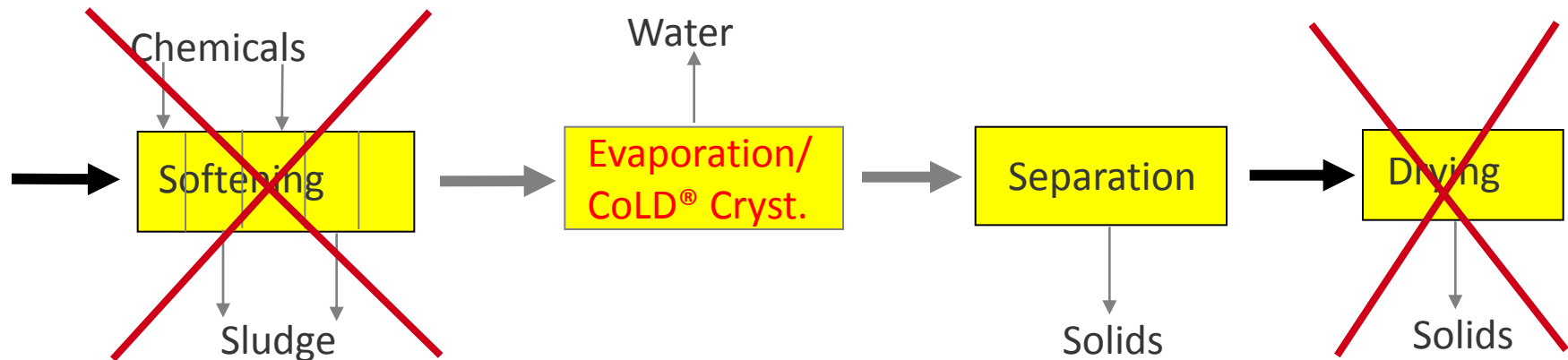


CoLD[®] Process eliminates chemicals, reduces solids disposal and equipment footprint.

Basic Flowsheet for FGD ZLD



CoLD[™] Flowsheet for FGD ZLD



Crystallization

of high solubility salts at

Low Temperature and

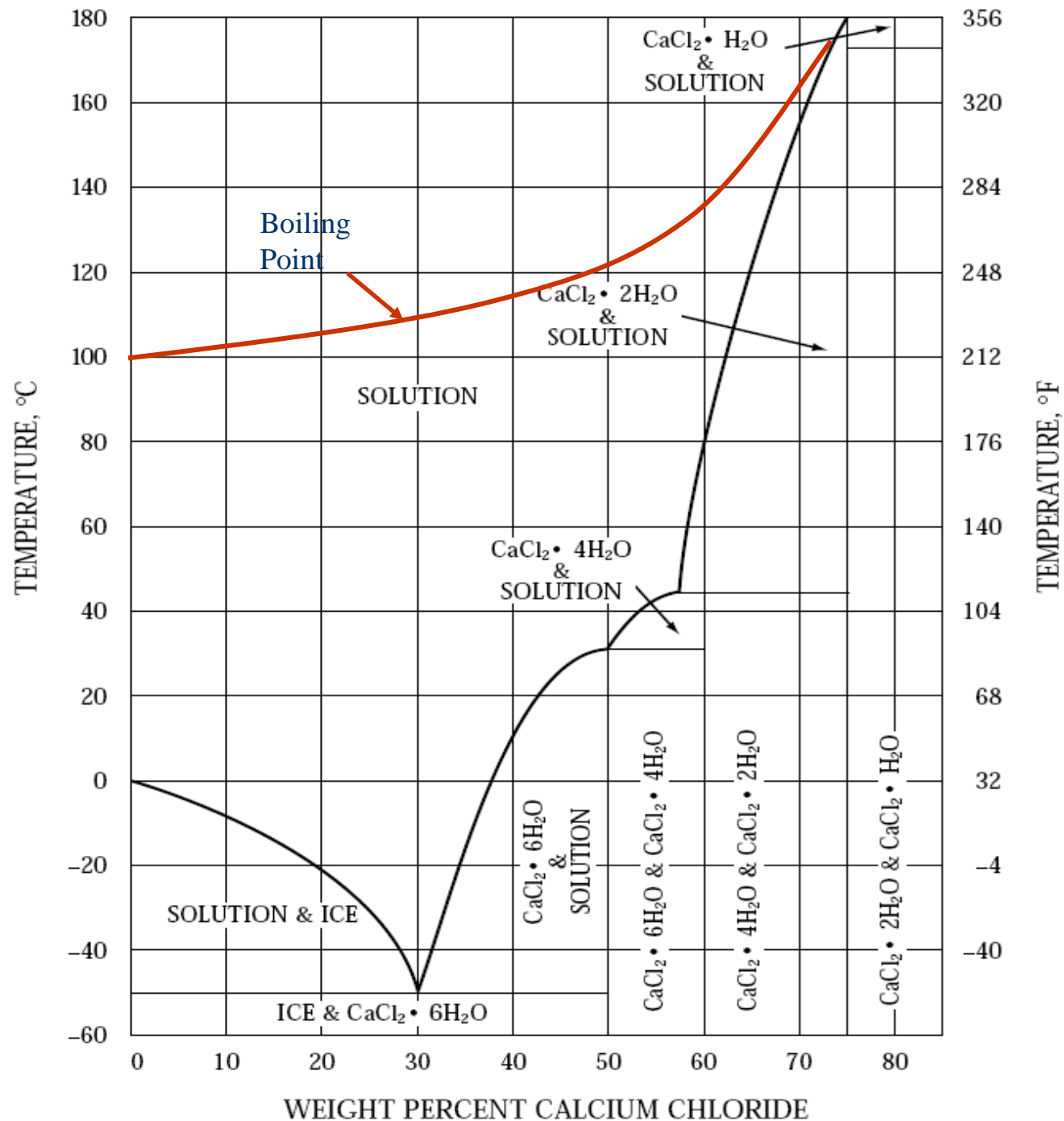
Deep Vacuum

U.S. Patent 8,052,763



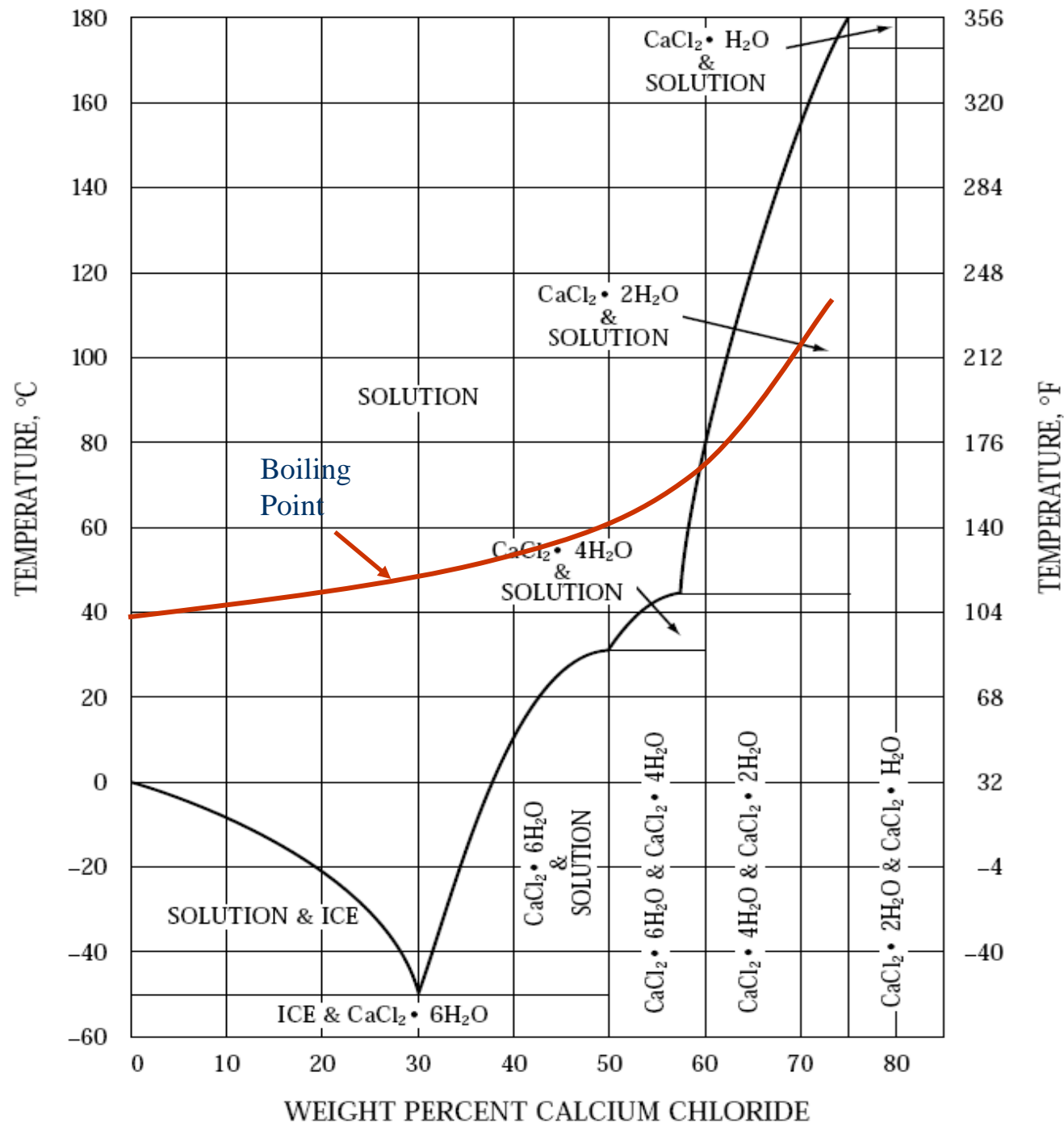
Phase Diagram of Calcium Chloride

At atmospheric pressure, the boiling point curve chases the solubility curve.



Phase Diagram of Calcium Chloride

Under vacuum, the boiling point is lower and a solid phase can form at a lower concentration



Economic comparison of FGD ZLD Options

Facility Comparison

- ▶ Conventional ZLD: 350 gpm capacity, Softening, Evaporator, Crystallizer
- ▶ CoLD ZLD: 350 gpm capacity, Evaporator, CoLD[®] Crystallizer

Economic Comparison

	Conventional	CoLD
Cap - Amor	\$5.4MM	\$5.4MM
O&M	\$2.8MM	\$2.8MM
Chemicals	\$6.3MM	\$250k
Disposal	\$4.5MM	\$1.0MM
Energy	\$1.8MM	\$2.3MM
Total Opex	\$15.4MM	\$6.4MM
Net Annual Cost	\$20.8MM	\$11.8MM
\$/gal	\$0.125	\$0.071

Summary of Conventional and CoLD Processes

- Conventional:

FGD wastewater is pretreated using using lime and soda ash softening to replace calcium and magnesium, which form highly soluble chloride salts, and which are very difficult to crystallize.

- CoLD:

Low operating temperature lowers the solubility of the high solubility dissolved salts, so they crystallize at a much lower concentration. Softening equipment, chemicals and resulting sludge disposal costs are eliminated.





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