

SUPERCRITICAL WATER OXIDATION (SCWO) OF OBSOLETE PESTICIDES

**Presentation to
Obsolete Pesticides – A “Burning” Question**

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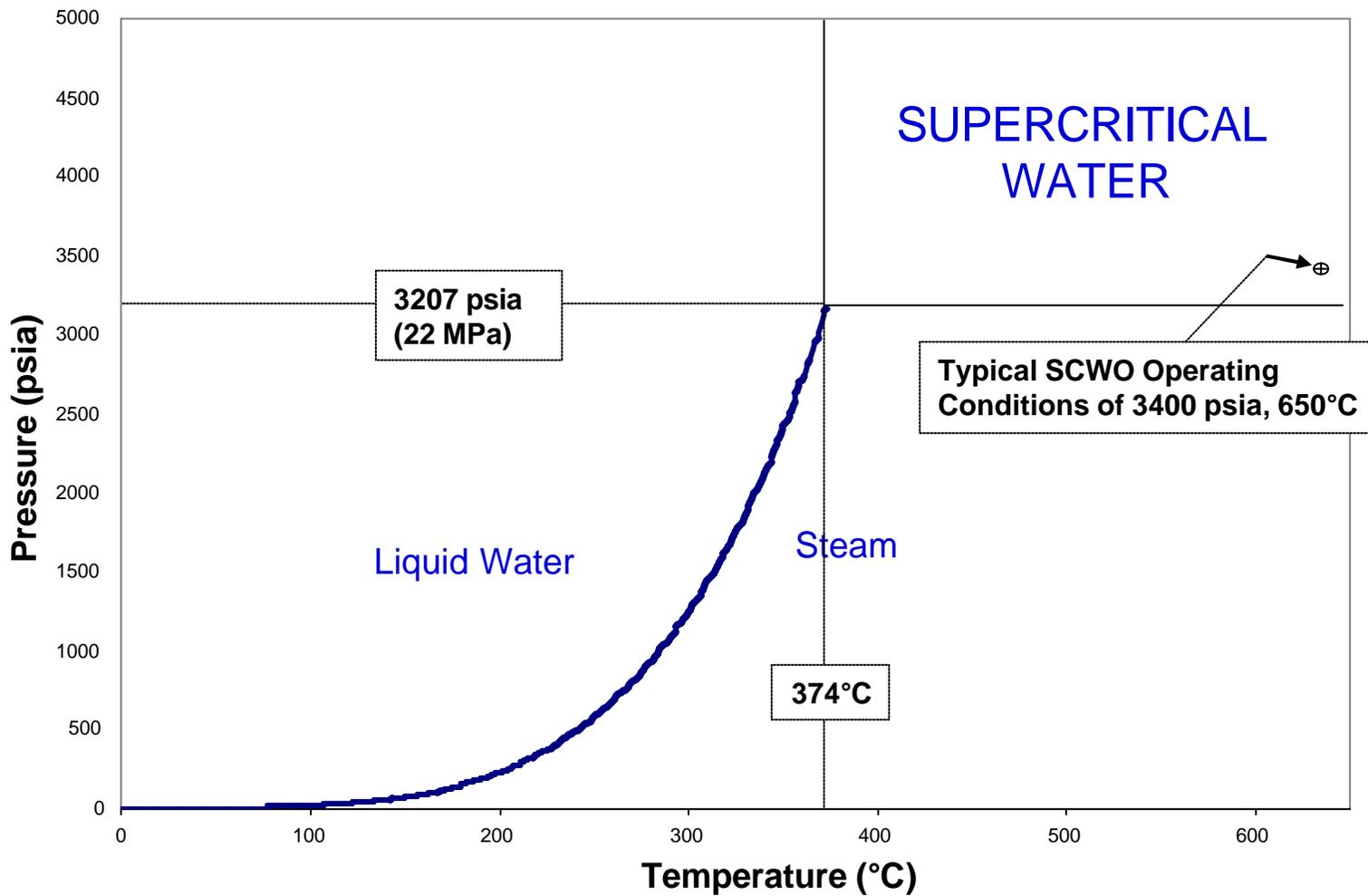
PRESENTATION TOPICS

- SCWO basics
- Applicable testing
- Blue Grass Chemical Agent-Destruction Pilot Plant (BGCAPP) SCWO
- Industrial SCWO (iSCWO) for obsolete pesticide application
- Conclusions/summary

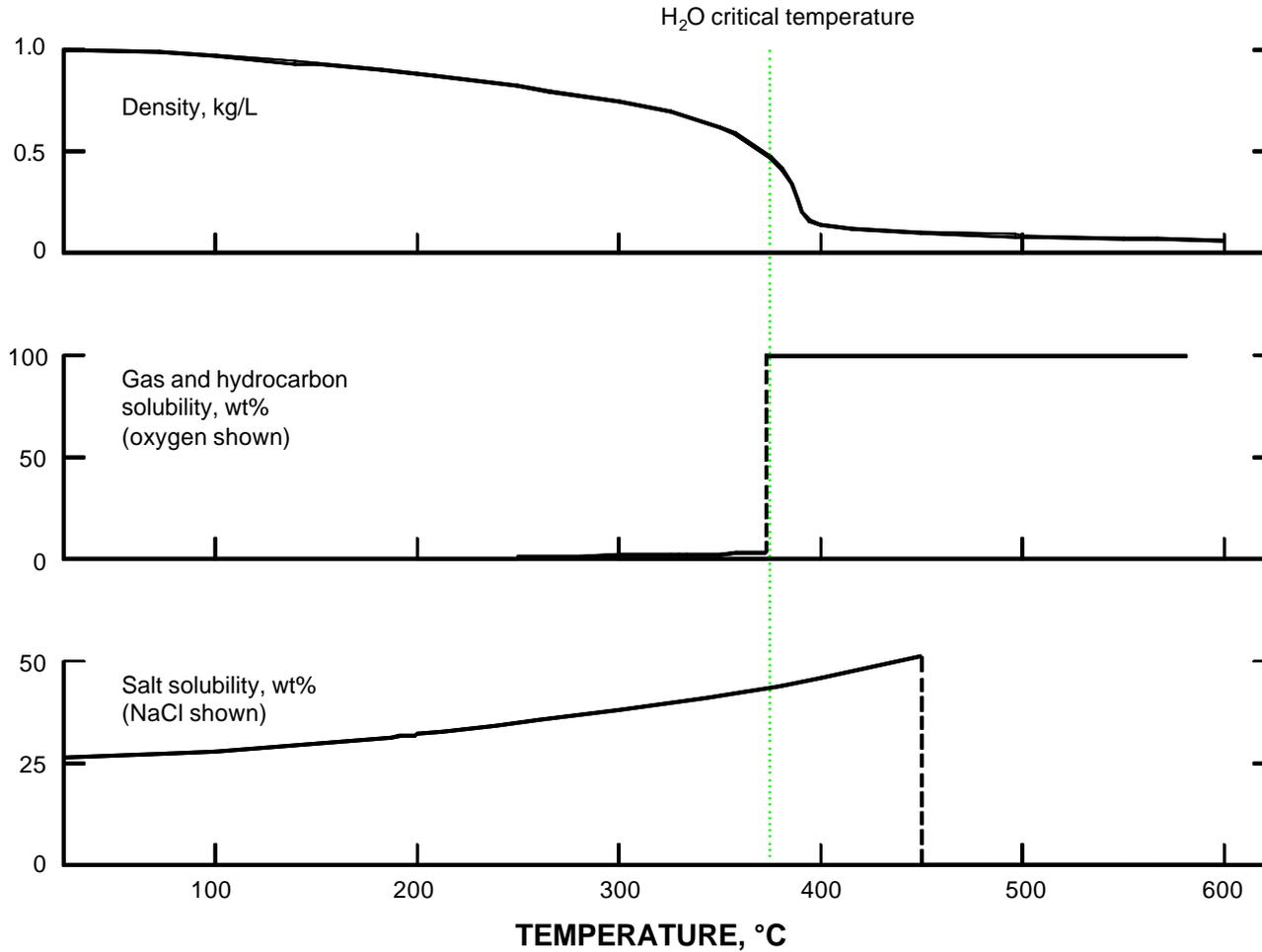
SCWO offers significant environmental advantages for the destruction of hazardous materials such as pesticides.

SCWO BASICS

WHAT IS SUPERCRITICAL WATER (SCW)?

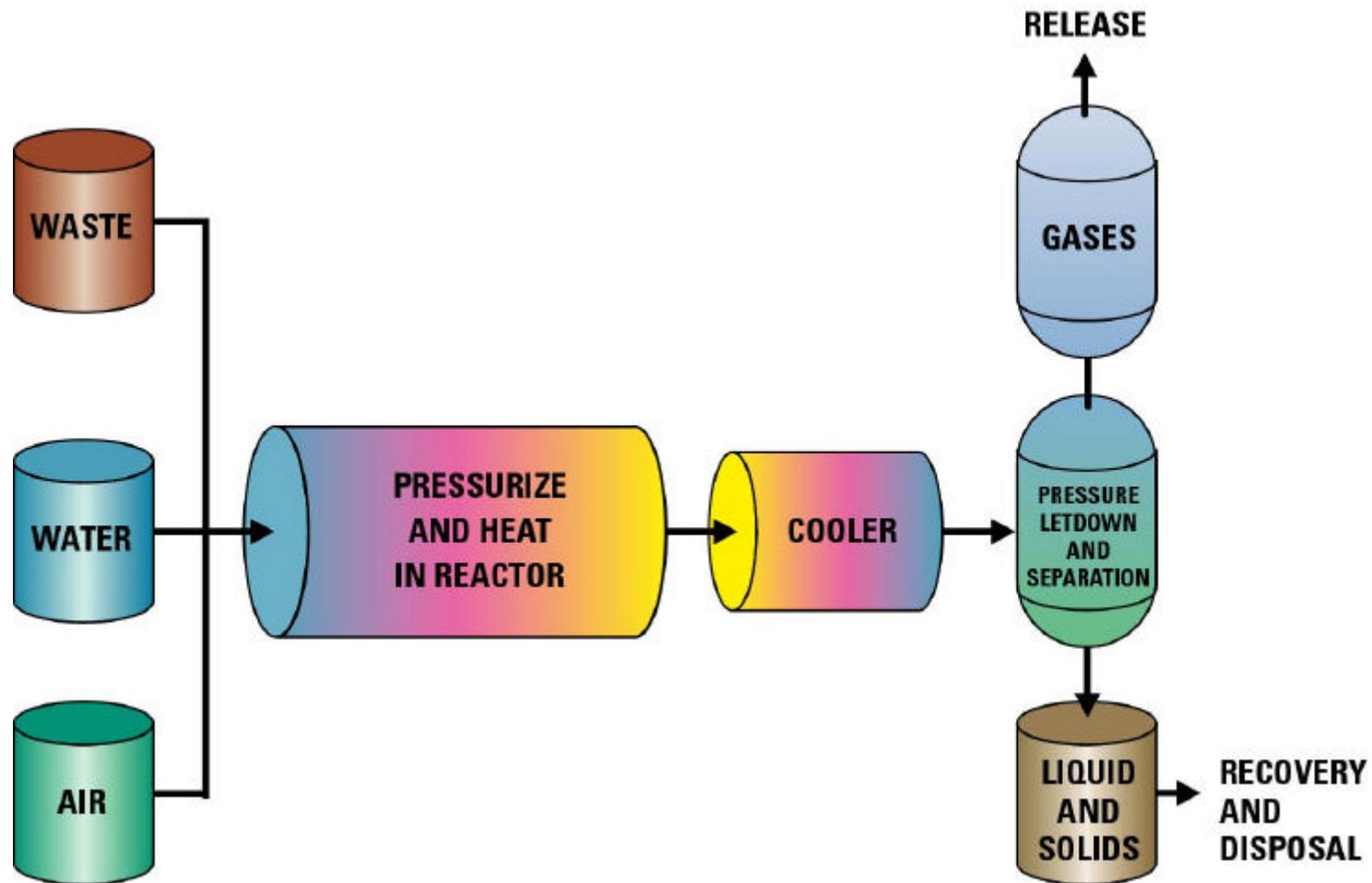


SCW PROPERTIES



PRESSURE = 25 MPa

CONCEPTUAL PROCESS FLOW OF A SCWO SYSTEM



SCWO HAS SIGNIFICANT ATTRIBUTES

- **SCWO Efficiently Oxidizes Organic Wastes**
 - Above the critical point, hydrocarbons and gases are miscible with supercritical water – leads to very rapid, very thorough destruction of organics
 - Complete oxidation to CO_2 , H_2O , and salts
 - No acid gases or particulates
 - Low NO_x , SO_x , and CO
 - No pollution abatement equipment required

APPLICABLE TESTING

WIDE RANGE OF APPLICABLE WASTES TREATED VIA SCWO

- **>18,000 hr of testing**
- **Destruction of over 200 organic compounds demonstrated, including:**
 - Hydrolysis products of GB and VX nerve agents (nerve agents are organophosphates similar to a major class of pesticides)
 - Dioxins and Furans
 - PCBs
 - DDT
 - Numerous similar compounds and mixtures (see handout)

SCWO TO DATE AIMED PRIMARILY AT CHEMICAL AGENT NEUTRALIZATION PRODUCTS

- **~8,000 hr of testing**
 - GB hydrolysate
 - VX hydrolysate
 - Mustard hydrolysate
 - Energetics hydrolysate
- **Pilot plant feed rates up to 350 lb/hr (~160 kg/hr)**
- **Complete destruction – total organic carbon (TOC) concentration in liquid effluent of <1 ppm.**
- **The use of removable/replaceable liners and control of process chemistry ensure reliable, continuous operation**

VX HYDROLYSATE TEST FACILITY



VX Hydrolysate
Drum Storage

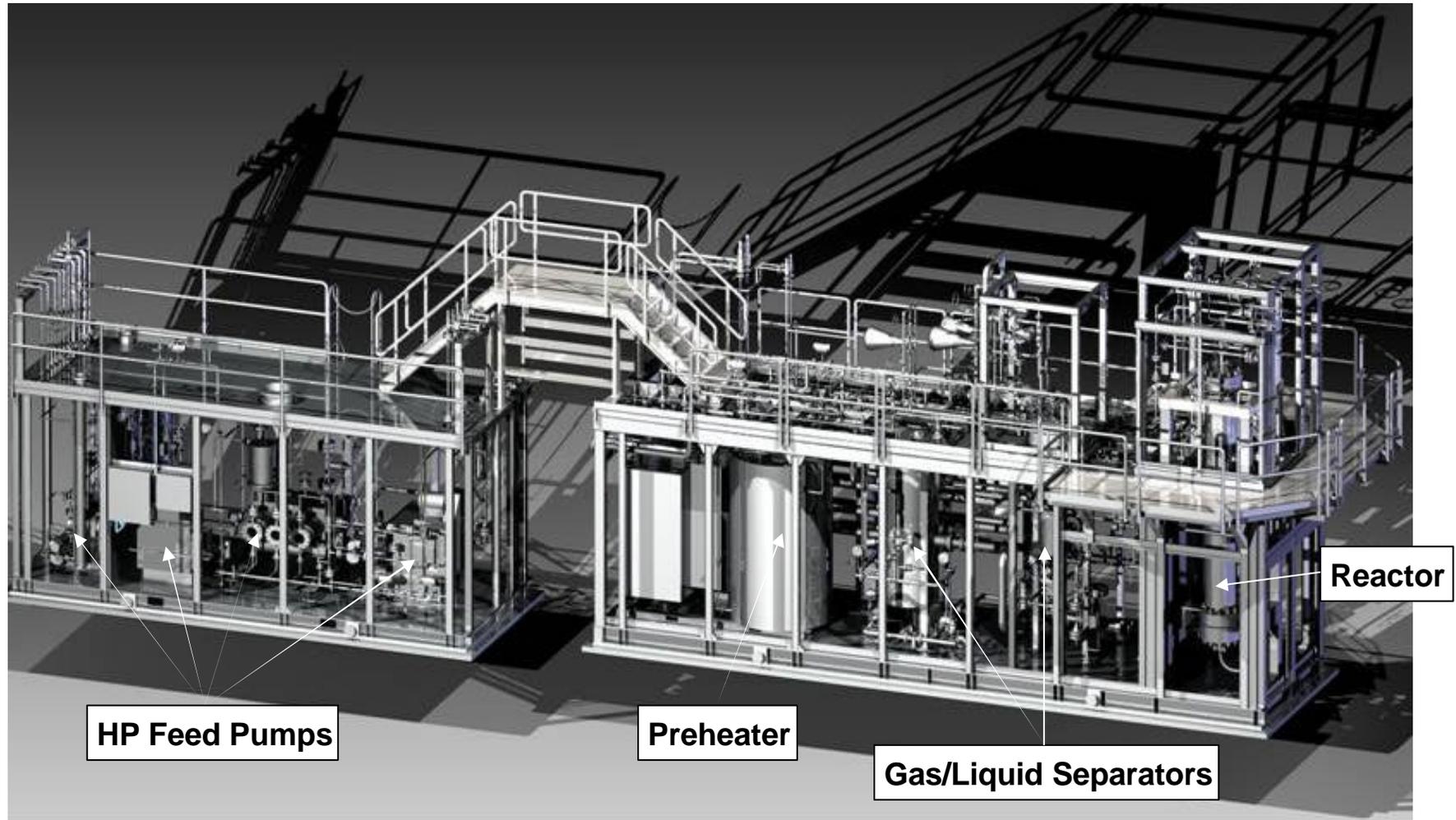


BLUE GRASS CHEMICAL AGENT- DESTRUCTION PILOT PLANT (BGCAPP) SCWO

BGCAPP SCWO OVERVIEW

- **General Atomics is part of the Bechtel Parsons team responsible for design, construction, operation, and closure of a facility to dispose of the chemical munitions inventory at the Blue Grass Army Depot**
- **Agent/energetics destruction technology being implemented is neutralization followed by SCWO**
- **Three SCWO units rated at 1000 lb/hr (450 kg/hr) to be supplied for treatment of the neutralized agent and neutralized energetics waste streams**

BGCAPP SCWO UNIT FOR AGENT HYDROLYSATE AND ENERGETICS HYDROLYSATE DESTRUCTION



INDUSTRIAL SCWO (iSCWO)

THE iSCWO SYSTEM

- **Simplified, robust design targeted at specific industrial and military applications**
- **Modular and portable**
- **Low capital cost**
- **Small footprint**
 - 8 ft x 20 ft (2.4 m x 6.1 m) for main skid
 - 6 ft x 20 ft (1.8 m x 6.1 m) for compressor skid)
- **Minimal personnel requirement**

The iSCWO design would be used for the destruction of obsolete pesticides.

INDUSTRIAL SCWO (iSCWO)



iSCWO HP AIR COMPRESSOR



SCWO REACTOR

- **Downflow plug reactor**
- **Made from high-strength corrosion-resistant materials**
- **Code approved and stamped by American Society of Mechanical Engineers (ASME)**
- **Fitted with a removable liner that can be fabricated from a variety of corrosion-resistant materials (e.g., titanium)**

SCWO REACTOR AND ENCLOSURE



SCWO PROVIDES EFFICIENT AND COMPLETE ORGANIC DESTRUCTION

Pollutant	Incinerator Limit	SCWO	Improvement Factor
Dioxins and Furans, TEQ ng/dscm	<0.2	<0.006	> 30 x
Particulate Matter, mg/dscm	<34	<4	> 8 x
HCl, ppmv	<21	<0.4	> 50 x
CO, ppmv	100	0.1	1,000 x
NOx, ppmv	variable	<10	N/A
Hydrocarbons, ppmv	<10	<0.03	300 x

No Pollution Abatement System (PAS) required.

iSCWO SYSTEM UTILITY AND SUPPORT REQUIREMENTS

- 480 VAC, 3 ph, ~1200 amp service
- Water @ 30-50 psig (2.1-3.4 bar) supply, 18 gal/min (gpm) (~70 liter/min)
- Instrument air
- Propane (natural gas) – 1000 st ft³/h (2500 st ft³/h)
28 st m³/h (71 st m³/h)
- Calibration gases – O₂ and CO
- NaOH
- Tanks – feed and effluent collection
- Low sulfur, diesel fuel

ESTIMATED COSTS FOR 3-GAL/MIN (11.4 LITER/MIN) iSCWO SYSTEM

- **Capital Cost – \$1.7M U.S. (1.2M Euro)**
 - SCWO unit and HP air compressor
 - Assumes site provides feed and effluent tankage and any required feed pre-treatment
- **Operating Cost – \$0.15 to \$0.35 per pound
(230-540 Euro per metric ton)**

PESTICIDE PRETREATMENT SCENARIOS

- **Feed must be pumpable to SCWO**
 - Slurry with water
 - Dissolve in solvent (preferably a waste also requiring disposal)
 - Dissolve in water (if sufficiently soluble)

SOLID WASTES CAN BE SHREDED AND/OR SLURRIED, AND PROCESSED VIA SCWO

WOOD SHREDDER



Micronized Wood

PLASTIC/RUBBER SHREDDER



Micronized Plastics/Rubber

HYDROPULPER SLURRIES WASTES FOR FEED TO SCWO



Slurry

Slurried and ready for feed to SCWO

CONCLUSIONS/SUMMARY

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- **SCWO is an exceptionally clean waste destruction process fully capable of destroying all classes of obsolete pesticides**
- **SCWO to be implemented soon for major waste destruction project in the U.S. – chemical agent destruction facility at Blue Grass**
- **The iSCWO system is a simple and robust commercial version of SCWO that provides hazardous waste treatment/disposal at an affordable cost**

CONCLUSIONS/SUMMARY (CONT'D)

- **iSCWO is being implemented at several sites in the U.S.**
 - 3 gal/min (11 liter/min) unit for U.S. Air Force/commercial company in Alaska – *fabrication complete and awaiting shipment to site*
 - 3 gal/min (11 liter/min) unit for Tooele Army Depot – *delivered to site and awaiting installation*
 - 10 gal/min (38 liter/min) unit for Blue Grass Army Depot (non-chemical agent wastes) – *in design/procurement phase*