THE TREATMENT

OF

WOOD PRESERVING INDUSTRY

PROCESS WASTEWATER

AND GROUNDWATER

USING

Solarchem's RAYOX®

ENHANCED OXIDATION

PROCESSING (EOP)

RAYOX® - OUTSHINING THE TREATMENT ALTERNATIVES

PRESENTATION OUTLINE

PART A

- WHEN CAN ENHANCED OXIDATION HELP
- HOW DOES IT WORK
- WHERE HAS IT BEEN APPLIED TO PROCESS WASTEWATER
- WHAT ARE THE KEY FACTORS GOVERNING COST AND PERFORMANCE

PART B

- WHO HAS RECOGNIZED THE POTENTIAL FOR GROUNDWATER EOP
- WHY DOES SECOND GENERATION EOP MAKE GOOD SENSE IN EITHER APPLICATION

WHEN CAN ENHANCED OXIDATION HELP

- WHEN PAH'S, PHENOLS, PCP, DIOXINS ETC. MUST BE DESTROYED ON SITE AT MINIMUM COST
- OR WHEN YOU WANT TO AVOID SECONDARY DISPOSAL REQUIREMENTS OF HAZARDOUS MATERIALS (B10 SLUDGES, PCP ON GAC, AIR EMISSIONS)
- WHEN YOU NEED TO AUGMENT THE REDUCTION CAPABILITY OF AN EXISTING BIOLOGICAL TREATMENT SYSTEM
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- OR WHEN INFLOW CONCENTRATIONS OR VOLUMES VARY REGULARY
- WHEN DISCHARGE PERMITS REQUIRE "DEEP DESTRUCTION" (99.99+%) TYPICAL OF PROCESS WASTEWATER
- OR WHEN GROUNDWATER ORGANIC CONTAMINANT REDUCTION OF 2 - 3 NINES IS APPROPRIATE

HOW DOES IT WORK

- $0_3/H_20_2$ —(UV)— OH° (HYDROXYL RADICAL)

- OH° OXIDIZES THE CONTAMINANTS TO $C0_2$ + H_20 + SIMPLE ORGANICS

- THIS REPRESENTS FIRST GENERATION TECHNOLOGY

- RAYOX® SECOND GENERATION SYSTEMS ADD THREE MAJOR IMPROVEMENTS:

  1) LIGHT DRIVEN DESTRUCTION FROM UV LAMPS MATCHED TO THE ABSORPTION SPECTRUM OF THE CONTAMINANTS PRESENT

  2) PATENTED RATE ENHANCING AND SELECTIVITY "CATALYSTS" DESIGNED TO REDUCE OPERATING COSTS AND

  3) SIGNIFICANTLY IMPROVED REACTOR DESIGNS

WHERE HAS IT BEEN APPLIED TO PROCESS WASTEWATER

I. IN OPERATION

- LOCATION: CENTRAL CANADA

- FLOW: 3 - 5 GPM

- PERFORMANCE:

	IN SPEC.	OUT SPEC.	ACTUAL
PHENOL	250 PPM	<15/30 PPB	ND-10 PPB
PCP	100 PPM	<10/20 PPB	ND-10 PPB
O & G	<100 PPM	< 2/4 PPB	ND
DIOXINS	60 PPB	-	ND (<1 PPT)

- CYCLE TIME: 10 - 12 HOURS

- OPERATING COST: < $10.00/1000 GALLONS* (12% OF PREVIOUS GAC COSTS 20% DCF R0I)

II. PENDING APPROVAL

- LOCATION: NORTH EASTERN U.S.

- FLOW: 1 - 2 GPM

- PEFORMANCE: (DESIGN)

	IN SPEC.	OUT SPEC.
PHENOL	300 PPM	<300 PPB
CRESOL	100 PPM	<300 PPB
PAH'S	10 PPM	<300 PPB
O & G	150 PPB	-

- CYCLE TIME: 20 HOURS

- OPERATING COSTS: $40/1000 GALS* (12% OF CURRENT COST - 1 1/4 YR. PAYBACK)

III. UNDER DESIGN

- LOCATION: SOUTHEASTERN U.S.

- FLOW: 7 - 8 GPM

- PERFORMANCE:

	IN SPEC.	OUT SPEC.
PAH	100 PPM	< 12 PPM
PHENOL	200 PPM	< 12 PPM
PCP	5 PPM	<100 PPB

- CYCLE TIME: 10 - 12 HOURS (ESTIMATE)

- OPERATING COST: $10 - $15/1000 GAL (EST.)* (20% OF CURRENT COST)

* OPERATING COSTS INCLUDE:

- POWER
- OXIDANT COSTS (H_2O_2,O_3)
- CATALYST
- LAMP REPLACEMENT
- PH ADJUSTMENT

WHAT ARE THE KEY FACTORS GOVERNING COST AND PERFORMANCE

1. THE NATURE OF THE CONTAMINANTS:

   - CHOICE OF OXIDANT, CATALYST AND UV LIGHT

   - PAH'S >> PHENOLS > PENTA >>>> WOOD CHEMICALS

2. THE INITIAL CONCENTRATION:

   - AMOUNTS OF OXIDANT AND CATALYST + PROCESSING TIME

   - OPS. COST INCREASE = CONC. INCREASE $^{0.6}$ I.E.: NON LINEAR

3. THE FLOW RATE:

   - NUMBER & DESIGN OF REACTORS + LAMP POWER

4. THE DEGREE OF DESTRUCTION REQUIRED:

- PROCESSING TIME + TREATMENT STAGES + REACTOR DESIGN

5. THE RESIDUAL OIL CONTENTS:

- THE LOWER THE OIL, THE LOWER THE OPERATING COSTS

6. THE POTENTIAL FOR UV LAMP FOULING

- SECOND GENERATION RAYOX® SYSTEMS UNIQUELY HAVE AN AUTOMATED UV LAMP CLEANING MECHANISM

- WHICH MINIMIZES SYSTEM MAINTENANCE REQUIREMENTS, AND

- MAXIMIZES UV AVAILABILITY

WHO HAS RECOGNIZED THE POTENTIAL FOR GROUNDWATER EOP

1. AN OPERATING FACILITY

- LOCATION: SOUTHEASTERN U.S.
- FLOW: 105 GPM
- PERFORMANCE:

	IN SPEC.	OUT SPEC.	DESIGN
PHENOL	2 PPM	<3.0 PPM	ND(<1 PPB)
PCP	<100 PPB	<9 PPB	ND(<1 PPB)
PAH'S	2 PPM	<1 PPM	ND(<1 PPB)

- OPERATING COSTS: $1.50/1000 GALLONS

II A DEFUNCT PLANT

- LOCATION: EASTERN CANADA
- FLOW: 50 GPM
- PERFORMANCE:

	IN SPEC.	OUT SPEC.
PHENOLS	<10 PPB	< 10 PPB
CRESOLS	<10 PPB	< 10 PPB
PCP	< 2PPM	< 10 PPB

- OPERATING COST: $1.00/1000 GALLONS

III AN OPERATING FACILITY

- LOCATION: NORTH EASTERN U.S.
- FLOW: 20 GPM
- PERFORMANCE:

	IN SPEC.	OUT SPEC.
PAH'S	< 10 PPM	N.D. (<1 PPB)

- OPERATING COST: $1.50/1000 GALLONS

NOTE: SYSTEMS I AND III EFFLUENT ARE TO BE COMBINED WITH ENHANCED OXIDATION TREATED PROCESS WASTEWATER IN ORDER TO MEET THE RELEVANT POTW AND SURFACE DISCHARGE PERMITS RESPECTIVELY

WHY DOES SECOND GENERATION EOP MAKE GOOD SENSE FOR EITHER APPLICATION

- IT IS A DESTRUCTION TECHNOLOGY
- WITH NO SECONDARY DISPOSAL REQUIREMENTS AFTER TREATMENT
- IT REQUIRES ESSENTIALLY NO OPERATOR TIME OR SKILL
- AND CAN BE "TURNED UP OR DOWN" TO MEET CHANGING INFLUENT CONDITIONS
- IT CAN ACHIEVE VIRUTALLY ZERO DISCHARGE CONCENTRATIONS (<99.999% DESTRUCTION) FOR GROUNDWATER AT REASONABLE COST
- WHICH AFFORDS THE POTENTIAL TO COMBINE PROCESS WASTEWATER EFFLUENT (OFTEN AT ONE-TENTH THE FLOW RATE) AND STILL MEET CURRENT POTW/SURFACE DISCHARGE REGULATIONS

- IT IS SIGNIFICANTLY LESS EXPENSIVE THAN TRADITIONAL OPTIONS (GAC) ESPECIALLY AT LOW CONCENTRATIONS

- AND THROUGHPUT OR DESTRUCTION CAPABILITY CAN BE INCREASED WITH VIRTUALLY NO INCREASE IN CAPITAL INVESTMENT (JUST ANOTHER REACTOR OR A DIFFERENT POWER LAMP)

- WHICH IS GOOD NEWS AS LOW CONCENTRATION STORMWATER RUNOFF MAY NEED TO BE TREATED, OR DISCHARGE LIMITS MAY BE LOWERED, IN FUTURE.