The original company Separation and Recovery Systems was founded in 1972 by the actor John Wayne (The Duke) with the purpose of developing and producing oil water separators for the maritime industry. The company eventually branched into high speed centrifugal separation of oily petroleum waste. In 1984 the US Congress enacted the Hazardous and Solid Waste Amendments (HSWA) to the Resource Conservation and Recovery Act (RCRA) commonly known as the Land Ban which severely limited the land disposal of Hazardous Waste Material in the United States. These are commonly known as Land Disposal Restrictions (LDR). In response to this broad regulatory legislation, in the early 1990’s Separation and Recovery Systems developed a hazardous waste recycling process, called the SAREX® process. The SAREX® process was designed to recycle and reduce the volume of newly regulated Land Ban waste generated from petroleum refining facilities. The process has been used extensively throughout the United States and in Europe, Asia and Latin America and is still in use today.

The new Separation and Recovery Systems has designed and is building state of the art updated mobile versions of the original SAREX® process utilizing lessons learned from over 30 years of operational experience and taking advantage of the well established recycling exemptions codified in 40 CFR 261. The systems is designed to be transportable and have a capacity to process 3-5 tons per hour of Hazardous or Non Hazardous refinery waste sludge with an annual process capacity of 20,000 tons per year.

Separation and Recovery Systems (SRS) has been a leader in providing waste minimization and remediation services to the petrochemical and utility industries. SRS designs and utilizes state-of-the-art processes to minimize the disposal of wastes and long-term liability while maximizing the recovery of useful products generated during separation.

SRS is UNIQUELY QUALIFIED to provide:

3-phase centrifugal separation for recovery of oil, water and solid phases.

Low temperature, indirect heated thermal treatment system for moisture and volatile organic removal.

Medium temperature indirect heated thermal treatment systems to produce solids that meet Universal Treatment Standards (UTS).

SRS also provides a full range of environmental and industrial services through its various affiliates and operating companies. SAREX® Process Systems have been implemented in refineries worldwide and SRS personnel have managed wastes for ARCO, Tosco, Shell, Marathon Ashland Petroleum, BP Oil, Fina Oil, Exxon, Total, PDVSA, Aramco, as well as other industrial clients.
The SAREX® Process

THE HISTORY
- SAREX® process technology was introduced in the late 1980's by a company originally founded by John “The Duke” Wayne.
- SAREX® process was developed to reduce petroleum sludge waste in the Industrial, Utility and Refining Industries.
- Over the years and today SRS stands out due to the upgrades and automation it has brought to the SAREX® technology.
- SRS has over 2 decades of SAREX® thermal processing experience.
- SAREX® process is proven technology supported by refinery clients through out the United States for over 20 years.
- SAREX® process has been used internationally within Mexico, France, Saudia Arabia, South Africa, Taiwan, Singapore and Venezuela.

SRS INTRODUCES AUTOMATED MOBILE THERMAL TECHNOLOGY
- Automated Feed System
- Fully Portable
- Computerized Process Information Tracking
- Higher Temperature Treatment to meet LDR standards (BDAT) Waste Delisting
- Integrated high efficiency technology resulting in substantial cost savings.

BENEFITS
- Elimination of Transportation Cost
- Priority Service with On site Technology
- Waste Minimization, Reduction and Delisting
- Oil Income and Reimbursement to client
- Legitimate Recycling & Product Recovery
- Water Disposal Cost Reduction on site
- Preferred On Site Process Pricing
- Proven Technology qualifies for legitimate recycling exemption though EPA 40 CFR regulations

- Substantial Volume and Waste Reduction
- RCRA Permitting exemptions
- Substantial reduction in disposal costs
The SAREX® Process is an integrated closed loop oily waste processing train that combines that SAREX® MX1500 for sludge dewatering and oil recovery, and thermal drying and contaminant desorption using the SAREX® MX2000 and MX2500 thermal processors.

THE SAREX® PROCESS PROVIDES TO THE CUSTOMER
1. Substantial volume and waste reduction (see example below).
2. RCRA permitting exemptions,
3. Substantial reduction in disposal costs.

SAREX® PROCESS APPLICATIONS
- Refinery K048-K052 sludges.
- Refinery and petrochemical F037-F038 sludges.
- Non RCRA BIO sludge thermal treatment.
- RCRA listed tank cleanout sludges.
- Lagoon cleanout sludges.

Note: Values are for Example purposes only.
**SAREX® PROCESS BENEFITS**
Achieve over 90 percent volume reduction.

Realize substantial reduction in disposal costs and more flexibility in disposal options, such as reusing treated solids in refinery or asphalt batching, land farming the solids, and other recycling options.

Process is RCRA exempt that meets 40 CFR 261.4 and 261.6 "closed loop" exclusion status. Processed solids also meet LDR standards and secondary materials exemption criteria.

Guaranteed treatment results and performance.

Price stability vs. incineration or cement kiln disposal options.

Flexibility to treat varied waste streams.

No capital investment required for customer.

Achieve TPH levels typically below 1 percent in processed solids.

**SAREX® PROCESS WARRANTY**
The recovered oil will contain less than 2 percent bottom solids & water (BS&W). Process and recovered water will be discharged to customer's specifications.

**SAREX® PROCESS EXPERIENCE**
The processed solids exiting the MX2500 will meet LDR standards.

Over 5,000,000 bbls of oily sludges processed using the MX1500 system.

Over 1,000,000 tons of solids processed using the MX2000 system.

Over 50,000 tons of solids processed to LDR standards using the MX2500.

A petroleum refinery can save at least $1,000,000 per year in using the SAREX® process to achieve LDR standards on K & F-listed solids disposal.

**GENERAL REQUIREMENTS**
1. 460 VAC, 3 phase, 60 hertz, 600 amp. at startup.
2. 200 x 200 feet non-reinforced 6-inch concrete pad with sumps.
3. 200 gpm of plant water.
4. Recovered oil and wastewater storage tanks.
5. Up to 6,000 lb. per hour 150 psig plant steam.
7. About 5 scfm of dry nitrogen or carbon dioxide gas.
THE SAREX® MX1500

The SAREX® MX1500 is a modular CENTRIFUGE SYSTEM for processing oily sludge from:

- Refining API/DAF sludge (K wastes)
- Livestream and tank cleanings
- Oil production wastes
- Refining K169-172 Sludge
- Chemical production wastes
- Waterway bottoms
- Geothermal pond sludge

The separated oil is recovered for reuse. The separated water can be treated and or reused. The centrifuged solids are discharged via a screw conveyor for subsequent thermal processing.

MX1500 BENEFITS

- Substantial volume reduction, typically greater than 80 percent.
- Recover oil for reuse.
- RCRA exempt process under 40 CFR 261.4 and 261.6 as well as other exceptions.
- Guaranteed process results.
- Proven technology; the SAREX system has processed over 5,000,000 bbls of oily sludge to date.
- MX1500 system is mobile, compact, and easy to operate.
- Meets benzene NESHAP requirements.
SAREX® MX1500 EXPERIENCE
The SAREX® MX1500 CENTRIFUGE system has processed over 5,000,000 bbls of oily wastes since its introduction in 1986.

The SAREX® MX1500 has been utilized extensively in refinery projects processing from 2,000 bbls to over 300,000 bbls. Millions of barrels of oil have been recovered using the SAREX® MX1500 CENTRIFUGE.

GENERAL REQUIREMENTS
• Working area of 100 feet by 100 feet or less.
• Safe lighting for non-daylight use.
• 480 VAC, 3 phase, 60 Hz, 300 amp start up.
• Recovered oil and wastewater storage containers.
• 150 psig, 2,500 lb./hr plant steam.
• Reinforced 6 inch thick concrete pad with sump.
• 15 psig, 10 gpm plant water.

SRS PROCESS WARRANTY
• The CENTRIFUGED solids will pass the EPA 40 CFR 260, 264, 265, and 270 Paint Filter Test.
• The recovered oil will contain less than 2 percent bottom solids & water (BS&W).
• Water discharge typically contains less than 1000 ppm TSS and 1000 ppm TPH and is suitable for most water treatment processes.
ABOUT THE SAREX® MX2000
The SAREX® MX2000 is a low temperature THERMAL PROCESSOR for processing wet solids generated from dewatered sludge, sediments, or soils.

The SAREX® MX2000 is a mobile steam heated thermal processor. Solids processing temperatures range from 180°F to 250°F. The solids are dewatered and the majority of residual oil and VOCs are desorbed from the solids matrix. The desorbed organic and water vapors are processed through the State-of-the-art SAREX® vapor recovery system (VRS). The dried solids exit the SAREX® MX2000 for either final disposition or for further SAREX® thermal processing using the MX2500.

MX2000 BENEFITS
• Can achieve over 50 percent volume reduction.
• Very flexible in dewatering various waste streams.
• Substantially reduces disposal.
• Operates in a continuous process
• Will desorb most VOCs
• Relatively low power consumption.
• Very safe, Class I Div. II explosion proof system.
• Additional recovery of desorbed oils.
• Easily permitted.
• Proven Technology experience
• Compact, and easily transported.

SAREX® MX2000 APPLICATIONS
• Refinery K048-K052 oily sludge.
• Refinery and petrochemical F037 and F038 sludge or filter cake.
• Refining sludge K169-K172
• Tank and pond cleanout sludge.
• Oily filter cake drying.
• Belt press cake drying.
• BIO sludge dewatering.

• Dewatering of hazardous wastes before entering an incinerator or cement kiln.
• Remediation of petroleum hydrocarbon soils.
• Remediation of chlorinated hydrocarbon soils
**MX2000 CASE STUDY**

Location: Petroleum refinery

Material: 4,000 wet feed tons of oily F or K-listed sludge containing 50% water, 15% oil, and 35% solids.

SRS reduced the disposal mass by about 60 percent; with additional benefits of reusing recovered oil.

Initial cost to incinerate @ $600 per ton: 2,400,000

Total SRS cost plus 1,600 tons to dispose: 1,400,000

Total SRS cost savings: $1,000,000 or an estimated $250/ton per feed ton

**SAREX® MX2000 EXPERIENCE**

The SAREX® MX2000 THERMAL PROCESSOR system has processed over hundreds of thousands of wet tons of oily solids. The SAREX® MX2000 process has been used extensively worldwide in refinery projects since its introduction in 1990.

**GENERAL REQUIREMENTS**

1. Working area of 100 feet by 200 feet.
2. 460 VAC, 3 phase, 60 Hz, 250 amp. startup.
3. Up to 8,000 lb./hr. 150 psig plant steam.
4. Process up to 6,000 pounds of moisture and organics per/hr
5. Safe lighting for non-daylight use.
6. Up to 150 gpm of 50 psi makeup water.
7. Recovered oil and wastewater storage containers.
ABOUT THE SAREX® MX2500 PROCESS
The SAREX® MX2500 is a transportable, medium temperature, electrically heated thermal screw processor that thermally desorbs semivolatile organics from sludge, sediments, or soils to levels below land disposal restriction (LDR) standards.

The screws in the SAREX® MX2500 are indirectly heated to obtain solids temperatures of 600°F to 800°F.

The solids enter the SAREX® MX2500 through an air tight conveyance system. The solids are processed through the MX2500 in typically, a nitrogen inerted environment. The treated soils exit the MX2500 thermal desorber and are cooled in an airtight, water cooled screw conveyance system.

The vapors containing the desorbed organics exit the thermal processor and are treated to below regulatory standards using the SAREX® vapor recovery system (VRS).

SAREX® MX2500 APPLICATIONS
• K-listed refinery sludges.
• F-listed refinery sludges.
• High TPH sludges, sediments or soils.
• Mercury/TPH impacted sludges.
• Pesticide/PCB impacted solids.
MX2500 PROCESS ANALYSIS SEMI-VOLATILE ORGANIC COMPOUNDS FROM K048-K051 WASTESTREAMS

at seven refinery locations

<table>
<thead>
<tr>
<th>CONSTITUENT</th>
<th>LIMIT (MG/KG)</th>
<th>LDR</th>
<th>FINISHED PRODUCT MEAN RESULT (MG/KG)</th>
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<tr>
<td></td>
<td></td>
<td>REF</td>
<td>A</td>
</tr>
<tr>
<td>Anthracene</td>
<td>28</td>
<td>ND</td>
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</tr>
<tr>
<td>Benzo(a)anthracene</td>
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<td>0.15</td>
<td>0.30</td>
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<tr>
<td>Benzo(a)pyrene</td>
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<td>0.10</td>
<td>0.20</td>
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<tr>
<td>Bis(2 ethylhexyl) phthalate</td>
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<td>ND</td>
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<tr>
<td>Chrysene</td>
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<td>1.67</td>
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<tr>
<td>Di-N-butyl phthalate</td>
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<td>ND</td>
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<tr>
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<tr>
<td>Phenanthrene</td>
<td>34</td>
<td>1.43</td>
<td>1.97</td>
</tr>
</tbody>
</table>

ND = Non-Detect

SAREX® MX2500 BENEFITS

• Achieves LDR standards for K- and F-listed sludge; therefore, the solids can be disposed of at a lower cost.
• Process rates of 6 to 12 tons per day.
• Achieves TPH levels below 1% for oily solids.
• Is easily transported, and skid-mounted.
• Class I, Div. 2 explosion proof.
• Easy to permit.
• Guaranteed to meet treatment standards.
• Continuous processing.

SAREX® MX2500 EXPERIENCE

The SAREX® MX2500 has been utilized in refineries since 1991

Fully delisted waste disposal can save a refinery millions of dollars in disposal costs.

The SAREX® MX2500 has processed over 100,000 tons of Listed waste solids to (LDR) standards.

GENERAL REQUIREMENTS

1. Working area of 100 ft x 200 ft.
2. 460 VAC, 3 phase, 60 Hz, 600 amp. startup.
3. Processes about 200 feed tons of solids per month.
4. 15 psig, 125 gpm plant water.
5. About 5 scfm of dry nitrogen gas.

Phone 1-856-848-3719 | www.sarexusa.com