

# Wind-Powered ARCHIMEDES SCREW PUMP

Dedication Program  Friday, October 21, 2016  HSIC

- 10:00AM Sign-In and Walk/Shuttle to Artifacts
- 10:30AM Program (details below)
- 11:00AM Shuttle/Walk Back to Interpretive Center
- 11:15AM Refreshments

Welcome **ADRIENNE DE PONTE**, Director, HSIC, HARD

Speaker **ROBERT O. WOODS, P.E. (Ret.)**, ASME  
The ASME History & Heritage Program

Speaker **DR. TERRY E. SHOUP, P.E.**, ASME Past President

Acknowledgement **MINANE JAMESON**, Board President, HARD

Speaker **PAT MAPELLI**, Real Property Manager, Cargill  
The Rich Legacy of the Salt Industry

Closing Remarks **ADRIENNE DE PONTE**



## map & directions

- Walk from Interpretive Center along main trail.
- Turn left through the gate to enter salt ponds.
- After entering gate, turn right and then loop left to the Archimedes Screw.

Total distance is .75 miles.



hayward shoreline interpretive center

A Facility of Hayward Area Recreation and Park District  
4901 Breakwater Avenue Hayward, CA 94545

Contact Information  
Phone 510.670.7270  
Email shoreline@haywardrec.org  
Web haywardrec.org

## history & heritage

Through its History & Heritage Program, the American Society of Mechanical Engineers (ASME) encourages public understanding of mechanical engineering, fosters the preservation of this heritage and helps engineers become more involved in all aspects of history.

In 1971 ASME formed a History & Heritage Committee composed of mechanical engineers and historians of technology. This Committee is charged with examining, recording and acknowledging mechanical engineering achievements of particular significance.

For information, please visit [WWW.ASME.ORG](http://WWW.ASME.ORG)

## landmark designation

Since the History & Heritage Program began, 262 artifacts have been designated throughout the world as historic mechanical engineering landmarks, heritage collections or heritage sites. Each represents a progressive step in the evolution of mechanical engineering and its significance to society in general. **THE LANDMARKS PROGRAM** illuminates our technological heritage and encourages the preservation of historically important works. It provides an annotated roster for engineers, students, educators, historians and travelers. It also provides reminders of where we have been and where we are going along the divergent paths of discovery.

## acknowledgements

*The Hayward Area Recreation and Park District gratefully acknowledges the efforts of all who cooperated on the dedication of the Archimedes Wind-Powered Screw Pumps as a Regional Historic Mechanical Engineering Landmark, particularly the staff at Cargill. Special thanks are extended to Don Holmquist, who originally restored the wind-powered pump and to Russ Gebhardt and Henry Pratt from HARD who restored it in its current home.*

—DEDICATION PLANNING COMMITTEE  
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JILL SINGLETON, CARGILL  
WIL HAYWOOD, ASME

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150 years of helping the world thrive



# Dedication of the Archimedes SCREW PUMP of the San Francisco Bay

## An Historic Mechanical Engineering Landmark



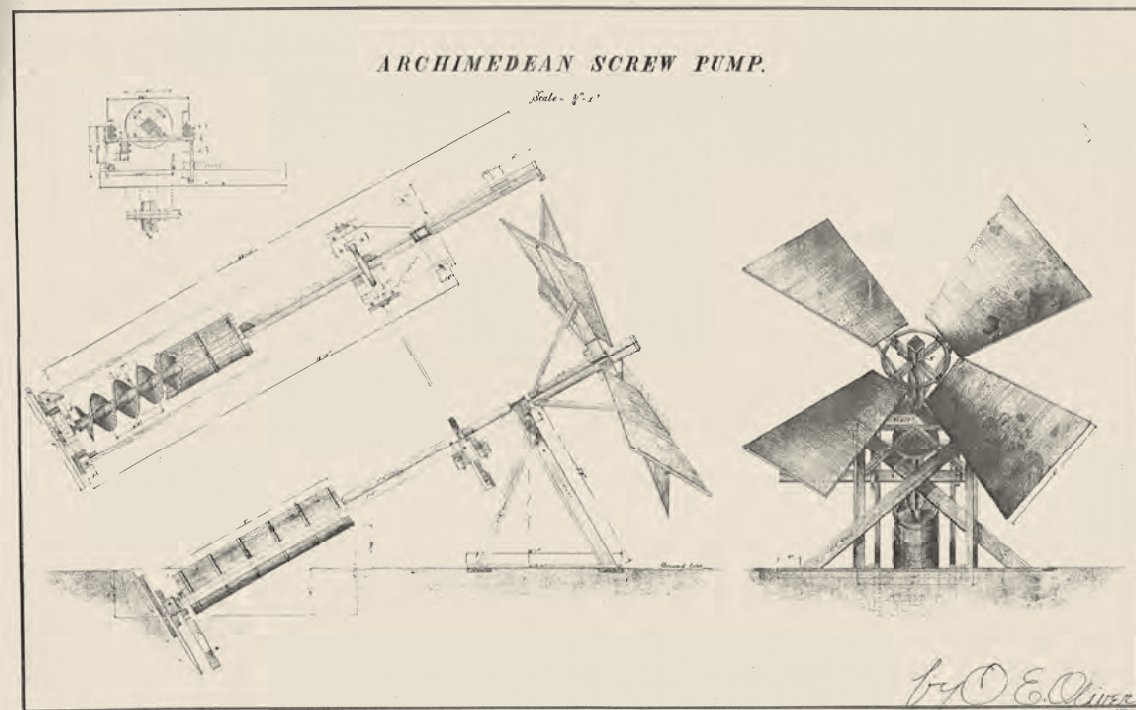
Hayward Shoreline Interpretive Center  
Hayward Area Recreation and Park District

in partnership with Cargill & the American Society of Mechanical Engineers



The San Francisco Bay Area is one of the few places in the world where salt is commercially recovered from brine through solar evaporation. The Bay itself provides the brine, and the mild climate provides favorable

atmospheric conditions. A long season of mild temperatures, little rainfall, and almost constant northwest wind allow efficient solar evaporation. The steady wind not only drives evaporation, but makes wind-powered pumps effective.



DRAWING OF ARCHIMEDES SCREW PUMP MADE IN 1891 BY OTTO EDWARD OLIVER.

## The Development of an Industry

In the mid-19th century, before the development of refrigeration, salt was an essential commodity used to preserve meat and fish.

In the 1860s, after discovery of the Mother Lode - a 120-mile-long quartz vein in the Sierra Nevada containing rich deposits of gold and silver - the need for salt increased greatly because of its use in refining silver. At first, salt was brought from the East Coast as ballast in ships, but its excessive cost generated a need for locally-produced salt. Before long, many small salt companies were formed. They built crude ponds with hand labor and dug out

the crystallized salt with picks and shovels. By 1868, some 17 companies harvested about 17,000 tons of salt annually.

Solar salt is produced from brines that are pumped through a series of increasingly saline evaporation ponds. When the brines reach saturation, the salt precipitates and is harvested. Wind plays a dominant role in concentrating the brines, and through the Archimedes Screw technology, powered the pumps that transferred the brine from one evaporation pond to another. The Archimedes screw pumps, originally designed and built



## Salt Harvest 2016 Style

Since acquiring Leslie in 1978, Cargill has replaced acreage with engineering, freeing up more than 40,000 acres of salt ponds for wildlife habitat, public access and education.

Today, Cargill produces about 500,000 tons of salt annually for food, agriculture, water conditioning and industry at its Newark Plant Site and Redwood City operation. It takes billions of gallons of salt water to produce that tonnage.

Although Cargill has modernized its technology, the same fundamental process of solar evaporation is used today as introduced 150 years ago. During the spring, brine from the bay is pumped into concentrating ponds that vary from 200 to 800 acres. As the brine evaporates and becomes more saline, it is moved from one pond to another of higher salinity. The brine undergoes ten stages of concentration, before reaching pickle, or saturation phase and arriving at the company's industrial plant sites.

During this five-year process, the brine changes from blue-green to a dark red due to the growth of halophyllic micro-organisms. The pickle is pumped into 20 to 90-acre crystallizers in late spring. Over the summer, salt crystallizes out.

By late summer, the crop of NaCl is ready to harvest. The remaining mineral solution, now called bittern, which contains magnesium, calcium, bromine and potassium, is drained from the crystallizers and pumped into ponds for further concentration into dust-control products and low-corrosive de-icers. Crews work the harvest five days a week, 16 hours a day, to complete as much as possible before the winter rains begin. Heavy, slow-moving harvesting machines, similar to farm combines, inch along the crystallizers, scooping up and loading the crystals into 30-ton haul trucks that transport the salt to a wash house. At the wash house, the salt is washed in clean saturated brine to remove the last traces of impurities.

The salt is then stored in 80-foot-high stacks that are visible for miles and serve as an aviation guide for hundreds of airplanes that fly in and out of the Bay Area each day. Some salt is sold directly from the stack but most salt undergoes one of two purification processes. Salt for human consumption is purified to 99.9 percent. Industrial, agricultural and water conditioning salts are cleansed to 99.8 percent purity.

by Andrew Oliver in the 1870's, were used until electric pumps came into general use beginning early in the twentieth century.

Two of the earliest and longest surviving salt companies were the Oliver Salt Company, founded by Andrew Oliver in 1872, and what was then the Leslie Salt Refining Company, founded in 1901. By 1936, with the invention of the mechanical harvester, Leslie dominated salt production, operating on 40,000 acres around the

Bay. Leslie Salt was purchased in 1978 by Cargill Incorporated of Minneapolis which continues to make salt today.

The Oliver family did not stay out of the business for very long after their company was absorbed by Leslie. In 1931, Andrew Oliver's grandsons, Alden and Adolph, bought the Johnson Salt property in 1937, built a new plant near the east end of the San Mateo Bay bridge, and as the Oliver Brothers Salt Company, produced salt there until 1981.

SALT HARVESTING BY THE BAY. HAYWARD AREA HISTORICAL SOCIETY



BASE OF OLD PUMP SHOWING REMAINS OF HELIX.



## From Hundreds Down to One

In 1978, Leslie's pond superintendent, Don Holmquist, decided to restore a wind-powered Archimedes screw pump to working order. Using O. E. Oliver's original drawing, Don and his colleagues painstakingly rebuilt this pump and placed it in a pond on Leslie property. With its 20-foot diameter fan blades turning a 22-foot long redwood shaft, this pump is a faithful reproduction of the originals used a hundred years ago.

From the beginning of the salt industry in the Bay Area until early in the twentieth century, all brine pumping in the salt ponds was done by means of wind-powered pumps of various designs, with probably hundreds in operation. In time, electric pumps were developed and eventually replaced their wind powered ancestors - despite their efficiency, wind is not available at all times.

The Archimedes screw pump consists of a continuous spiral chamber formed around an inclined enclosed redwood shaft which raises the water as the shaft is rotated by the four-bladed wooden windmill. With a wind of 25 miles per hour, the pump, turning at 60 rpm, will raise 1,500 to 2,000 gallons of water per minute. Assuming a 4-foot lift some 1.5 to 2 horsepower is represented.

The principle of the screw pump is traced to Archimedes, a Greek philosopher who lived in Sicily from 287 to 212 B.C. Pumps of this type were first used in Egypt, and then by Romans, even making their way to Japanese mines for drainage purposes. Originally muscle-powered, the windmill drive was added in 17th century Holland when such pumps began the reclamation of land from the sea. Small hand-cranked pumps of this nature are used by today's Egyptians for irrigation.

The Archimedes screw pump was restored as a reminder of the history of the salt industry adjacent to San Francisco Bay and placed at an outdoor museum, built by Cargill employee volunteers at the company's Newark plant site. In 1984, ASME designated the restored pump a Historic Mechanical Engineering Landmark.

For nearly 30 years, the company conducted public tours and many thousands visited the museum. Then in 2014, Cargill donated the Archimedes Screw to HARD, where it was re-assembled by Henry Pratt and Russ Gebhardt and placed at the site of the region's original commercial salt operation.

## Naturalist-Led Interpretive Hikes of the Oliver Salt Trail

DELIVERED TO HSIC in May 2015, the Archimedes Screw Pump stands tall, illuminating local and state history from its site along the Oliver Salt Trail. As a state-designated historic landscape, the former salt ponds and artifacts provide students a living sense of place where abstract facts, from Ohlone life to the gold rush, become an engaging and interactive discovery. Our Salt Pond History program is specifically designed for 4th grade students studying California history and social sciences. Using California State Standards for Social Science and Environmental Study, Interpretive Center naturalists present a dynamic picture of ancestral and early California life and industry.

DUE TO THE NESTING SEASON OF THE THREATENED SNOWY PLOVER, THIS SPECIAL PROGRAM IS ONLY AVAILABLE DURING THE FALL AND WINTER.



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