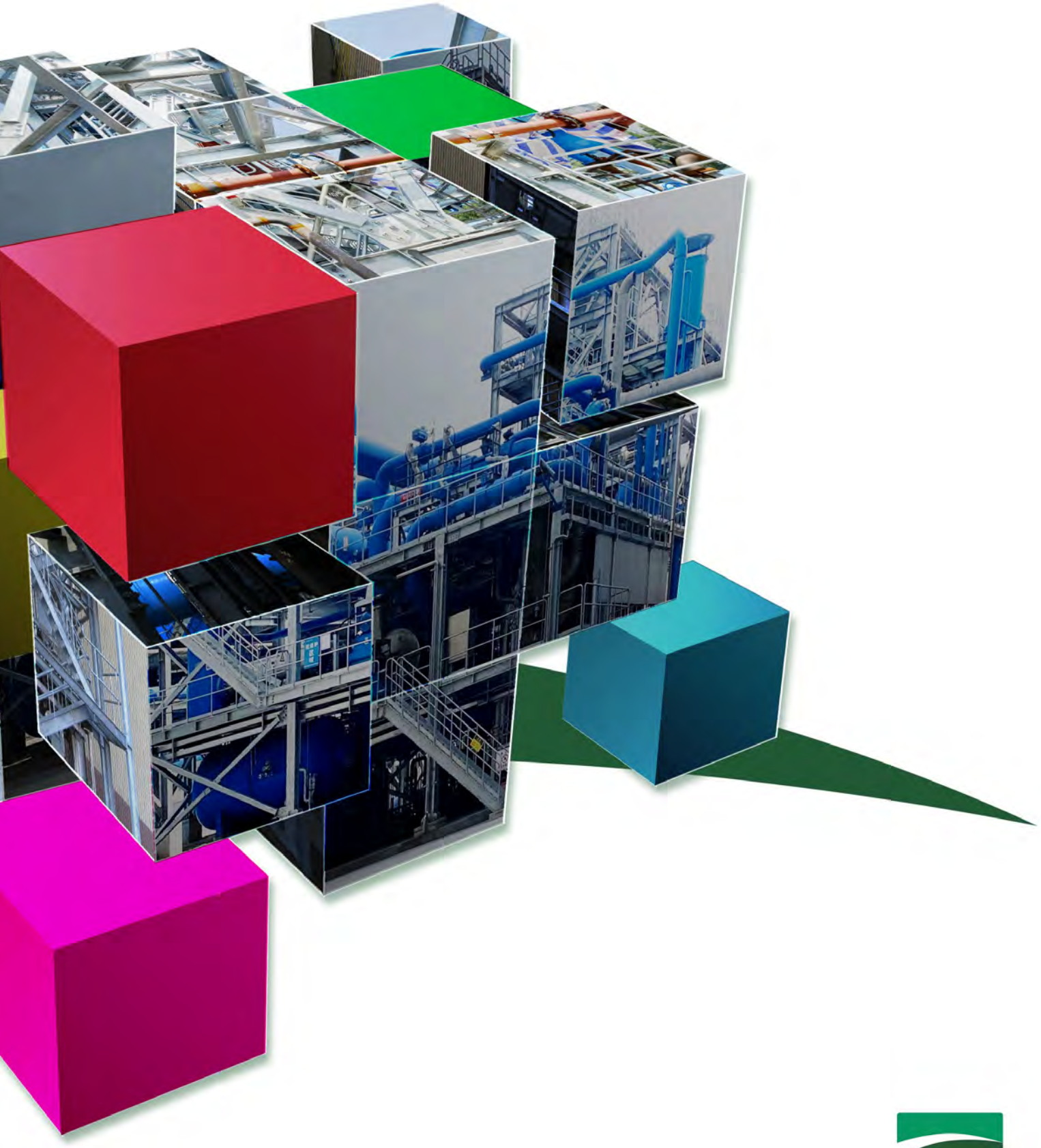
PRODUCTS & SERVICES



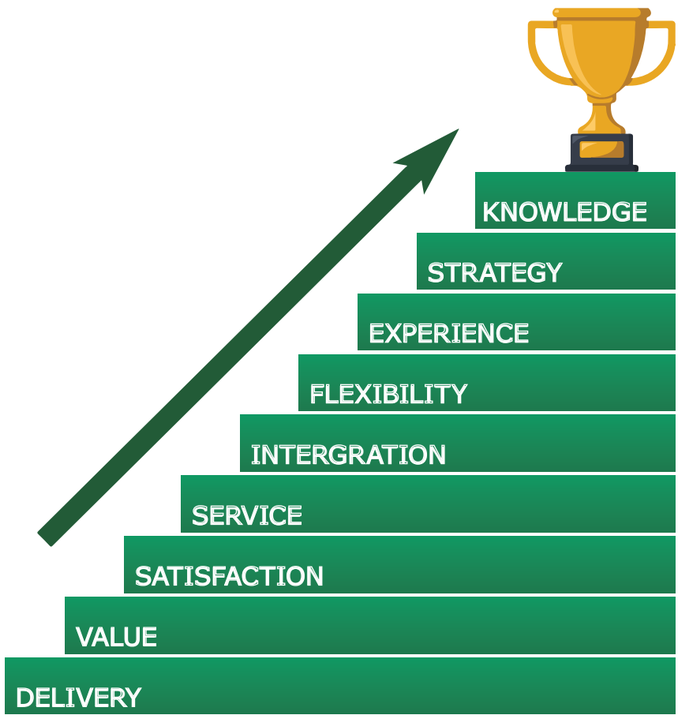
A.H. Lundberg Systems Limited®

Table of Contents

About Us

Since 1954, A.H. Lundberg Systems Limited® (AHLS) has grown from serving the Canadian pulping industry to being a leading global provider of industrial and chemical process solutions. Specializing in environmental control, evaporation, and energy recovery technologies with expertise in heat and mass transfer, our proven solutions span industries, that include pulp and paper, mining, oil and gas, food and chemical production, corn, wood panel board and mineral wool.

Our experienced team of process, mechanical, and ICE (instrumentation and control engineering) engineers utilizes cutting edge technology to deliver custom solutions tailored to our clients' needs. With a growing global network of representatives, we ensure seamless and reliable service for all the systems offered. Our team provides comprehensive services, including audits and studies, equipment and basic and complete engineering, procurement and construction (EPC) projects. Regardless of the scope, we are ready to respond with professionalism, expertise, and flexibility.



1920 – 1950: A.S. Lundberg's Rise

In the 1920s, Alerick Halvar Lundberg, known as "Mr. Sulphite," became a key figure in the West Coast pulp industry. He worked with PML and SF, guiding the shift from sulphite to kraft pulping. Lundberg's influence cemented his role as an industry leader.

1950 – 2000: AHLI and LAEL Era

In 1954, Alerick founded A.H. Lundberg, Inc. (AHLI) with his son Lennart. They expanded into evaporation and environmental solutions, impacting the Canadian pulping industry. AHLI's work helped shape global practices in recovery technologies.

2000 – 2023: AHLS' Global Expansion

In 2000, A.H. Lundberg Systems Limited® (AHLS) was launched under Bruce Der's leadership. AHLS grew into a global provider of environmental systems, branching out from pulp and paper into industries like oil, gas, mining, and chemicals. Known for strong project management and innovation, AHLS has upheld the Lundberg legacy for over 70 years.

Air Pollution Control

WASTE GAS COLLECTION

A. H. Lundberg Systems Limited® is the leading supplier of Non-Condensable Gas (NCG) collection systems to the pulp and paper industry, with over 200 systems installed worldwide.

We have over 70 years of experience designing and supplying waste gas collection systems, thermal oxidizers, boiler gas injection systems, and incinerators to handle all types of NCG sources. Our Thermal Oxidizer Systems are designed to handle gases of varying concentration and composition, and to meet or exceed all specified regulatory requirements. Our experienced team can solve problems related to waste gas management, in all process industries.

AHLS specializes in the design and installation of collection & handling systems to address:

- Concentrated Non-Condensable Gas (CNCG)
- Dilute Non-Condensable Gas (DNCG)
- Chip Bin Gas
- Stripper Off-Gas (SOG)
- Tank Vent Systems
- Low Pressure Feeder Vents
- Digester De-pressurization (DDP) System

Bio-gas and Landfill Gas Recovery Systems

Anaerobic digestion has proved successful in many applications for its ability to recycle biogenic wastes to produce bio-gas. While landfill gas (LFG) recovery has become a standard technology in most industrialized countries for safe and environmental energy recovery, these gases which contain up to 80% methane, have increasingly been used in combined heat and power (CHP) engines and turbines, or as a supplement to natural gas in industrial equipment such as boilers, dryers, and heat pumps.

AHLS can assist in determining the best usage for your bio-gas or landfill gas, and can provide complete gas collection, treatment, transport, and custom burner systems.

The AHLS waste gas collection and conditioning system may include the removal and recovery of condensates, gas reheating, and pressurization to safely convey the gases to the point of thermal oxidation. The thermal value and sulphur content of the waste gases typically determines which thermal oxidizer technology will be applied. The presence or absence of oxygen and toxins in the waste gas will dictate how it can be handled safely.

Waste gas pollutants addressed include air-borne particulate matter, acid mist, volatile organic hydrocarbons, inorganic gases, and combinations of these hazardous air pollutants.

Our experience for the destruction of waste gases includes the implementation of a variety of technologies, which include flares, power boilers, lime kilns, recovery boilers, direct-fired oxidizers (incinerators), regenerative catalytic oxidizers (RCOs) and regenerative thermal oxidizers (RTOs).

Installations range from complete system integration of the air pollution equipment, system add-ons and retrofits. The engineering and design of upgrades to meet progressively more stringent emissions requirements.

THERMAL OXIDIZER

Operators of industrial processes that emit Volatile Organic Compounds (VOCs) have long known that a thermal oxidizer is the best solution to employ in the destruction of these emissions. The challenge, however, is minimizing fuel and operating costs while destroying the VOCs.

AHLS offers a Direct Fired Oxidizer (DFO), which has the primary choice for disposal of the waste gas streams for many clients in the pulp and paper industry. The system is designed to thermally oxidize contaminants in waste gas streams such as concentrated and dilute NCG, chip bin gas, stripper off-gas.

AHLS thermal oxidizers are designed to incinerate varying concentration and composition of hazardous air pollutants to meet or exceed stringent environmental requirements.

AHLS has installed custom thermal oxidizers in many different industrial plants worldwide.

Direct Fired Oxidizer

AHLS DFO has been specifically developed over the years to withstand the harsh environments of the pulp and paper industry. It is also ideal for thermal oxidation of waste gases in other industries. The incinerator is designed to provide Volatile Organic Compounds (VOCs) and Total Reduced Sulphur (TRS) destruction efficiencies exceeding 99.99%. AHLS has many DFO systems operating worldwide.

Specialized Burner Nozzles

We offer custom-designed burner nozzles to safely inject the waste gas for complete destruction. The burner nozzles may be designed for a single fuel or a combination of multi-fuels.

These incinerators can be designed for continuous or intermittent (rapid start-up) operation, as appropriate. Waste Heat Boilers may be added to recover flue gas heat to produce steam.

AHLS direct fired oxidizers with a waste heat boiler are a proven economical and energy-efficient. Meeting global environmental regulations, these are designed to eradicate Hazardous Air Pollutants (HAP).

Our Flue-Gas Desulphurization (FGD) technologies effectively remove sulphur dioxide (SO_2) from exhaust flue gases.

Thermal oxidizers can improve:

- Fire tube waste heat boiler to generate low pressure steam
- A tail gas scrubber to capture sulphur compounds from the waste gas

Regenerative Thermal Oxidizer and Regenerative Catalytic Oxidizer

Although thermal oxidation is recognized as the best solution to destroy Volatile Organic Compounds, the challenge is to minimize the fuel and operating costs for the process.

AHLS Regenerative Catalytic Oxidizers (RCOs) meet the challenge of minimizing fuel (95% fuel savings versus no RCO) and operating costs. Regenerative Catalytic and Thermal Oxidizers provide a destruction efficiency of 98 to 99% of the VOCs.

AHLS RTO incorporates high preheat efficiency with broad operational flexibility. Industries can economically achieve compliance with strict local, provincial and federal emission regulations. The RTO is designed to safely operate from 840°C to 1100°C with 95+% thermal efficiency. Regenerative Thermal Oxidizer Regenerative Catalytic Oxidizer.

AHLS RCO provides industries with a proven, low temperature solution for VOC emission control. Compared to an equivalent duty of the RTO, the RCO is smaller and less expensive in capital and operating cost since it works at temperature as low as 450°C.

RTOs and RCOs are ideal for industrial processes such as:

- Panel-board dryers
- Petroleum storage tank vapours
- Bitumen storage tank ventilation
- Truck and rail car loading vent capture
- Ethanol storage tank ventilation
- Paint curing ovens, and
- Insulation manufacturing
- MeOH storage tanks vapours

WET ELECTROSTATIC PRECIPITATORS

The collection of fine particulate emissions is often one of the most difficult environmental control problems faced by industry. These sub-micron particles present a significant threat to human health and are one of the leading causes of smog. As regulatory pressure to reduce the emission of these particles to the environment escalates, industrial operators must look for technologies to meet this challenge at reasonable capital and operating costs.

AHLS Wet Electrostatic Precipitator (WESP or Wet ESP) System was developed specifically for that purpose. Our electrostatic precipitator design features a proprietary disk-in-tube electrode configuration and state-of-the-art high frequency power supply that maximizes the total electric field and available power to ensure the highest possible particulate collection efficiency. As a result, we are able to achieve up to 99% efficiency, and outlet, particulate matter loading of less than 10 mg/Nm³.

WESP Systems are widely accepted as the leading technology for control of difficult to collect fine particulate emissions.

Our advanced and comprehensive approach includes:

- Up-flow or down-flow configurations
- Optional full turnkey installation including tie-ins to the process
- Integrated water recycle, treatment and disposal systems
- Upstream cyclone
- Upstream and downstream chemical scrubbing
- Heavy-duty construction with stainless steel on all internal surfaces
- Higher corrosion resistant materials of construction available to meet process requirement as necessary
- Integration with RTO or RCO

ACID MIST AND PARTICULATE CONTROL

Before WESP

After WESP Installation

Simplicity
The low-pressure drop down-flow system will minimize the overall system pressure drop to less than 4 inches of w.c. This leads to lower ID fan HP.

Performance
High-frequency high voltage supply provides the highest power to the system to maximize the collection efficiency. The serrated disc type discharge probes maximize the corona discharge and thus the particle charging capacity of the system.

Longevity
Round tubes for the collection surface of the Wet ESPs provide the best performance and longevity. As the tubes are fully seal welded, crevice corrosion possibility is eliminated.

Durability
The WESP wetted components are constructed of 304-L stainless steel internal alloys. Only minimal use of carbon steel for the bottom skirt, stair tower, and access platforms. Higher alloys are also available.

GAS SCRUBBERS

A.H. Lundberg Systems Limited® provides a diverse range of gas scrubber technology to effectively, dependably, and economically address air pollution issues and ensure regulatory compliance.

Venturi Scrubber System

AHLS Venturi Scrubber System has been engineered to efficiently collect fine particulate and aerosols from industrial waste gas streams. Optimal design of venturi scrubbers requires a keen understanding of the desired collection efficiency, particulate mass loading in the gas stream, gas and particle densities, particle size distribution, allowable pressure drop, and site space restrictions.

Packed-bed Tower Scrubber System

AHLS Packed-Bed Tower Scrubber System is designed to absorb odours, VOCs, hydrocarbons, acid mists, and various organic and/or inorganic contaminants from a process gas stream.

How Packed-Bed Tower Scrubber systems work:

- Contaminant-laden gas enters the scrubber tower near the bottom and flows upward through a bed of mass transfer media
- Absorption liquid, selected for the process, is distributed evenly on top of the packed bed by a spray header or flooded trough header arrangement
- The intimate contact between the liquor and the gas flow results in absorption of the pollutants into the liquor as the gas flows upward through the media bed of the scrubber vessel
- Media is selected to provide optimum wetted-surface area in contact with the gas flow (ceramic, metal, or plastic)
- An aerosol coalescing and mist elimination section is integrated into the Packed-bed Tower Scrubber at the top of the vessel

Spray Tower Scrubber System

Similar to our Packed-bed Tower Scrubber, the AHLS Spray Tower Scrubber System absorbs aerosols from a process gas stream. However, spray tower is less susceptible to fouling. The trade-off is a lower absorption efficiency.

How Spray Tower Scrubber systems work:

- Within spray tower scrubbers, gas flows upward through multiple spray zones of scrubbing liquid, to give intimate contact between the liquor and the gas flow, ensuring absorption of the pollutants into the liquor
- Spray tower scrubbers will generally include side-stream filtration of the resulting slurry, waste liquor blow down handling and sorbent make-up systems
- Hot gas quenching and vapour condensing will also be included in the system, if necessary
- Wet electrostatic precipitators can be integrated into the top of absorption scrubbers to achieve enhanced removal and control of sub-micron aerosols and particulate matter.

FLUE GAS DESULPHURIZATION SYSTEMS

Flue gas desulphurization (FGD) systems play a vital role in reducing sulphur dioxide (SO_2) emissions from coal and oil-fired power plants, and other industrial processes like waste incineration. FGD helps to combat the harmful effects of SO_2, which can lead to acid rain that damages ecosystems, as well as respiratory issues in humans and animals. In response to environmental concerns, governments have imposed strict emission regulations to reduce it emissions.

FGD technology significantly lowers SO_2/SO_3 and particulate emissions, enabling the use of lower cost, low-sulphur fuels like natural gas and biomass for incineration of harmful gases. Various types of scrubbers exist, one system injects reagents into flue gas.

One common method, wet scrubbing, involves using caustic solution to react with SO_2 to generate a sulphates solution. Other reagents are available that can produce gypsum or ammonia-based fertilizer. AHLS has supplied many caustic based FGD system.

Water Pollution Control

WASTEWATER TREATMENT SYSTEMS

Stripping Columns

Distillation of the waste water stream through steam stripping is an effective method of treating process foul condensates (sour water) contaminated with hazardous hydrocarbons, sulfides, ammonia, methanol, and TRS.

Every AHLS stripping system contains the same basic components, including a feed tank, filter, condensate pre-heater, stripper column, and a reflux condenser.

System Benefits:

- Environmental compliance for BOD and COD
- Offload effluent treatment system
- Recover heat to produce steam, heat boiler feed water
- Produce clean stripped condensate for mill re-use
- Reduce odour from mill facility
- Concentrates contaminants into stream suitable for incinerators

Nanoflotation

AHLS and David Bromley Engineering are consortium partners working together to commercialize a unique technology called Nanoflotation.

This modern technology uses concentrated ionically charged nano environments to cause repulsion of colloidal solids followed by attachment of solids. The repulsion and attachment processes result in a rapid, low energy method to separate colloidal solids from fluids.

System Benefits:

This technology provides efficient water treatment to ultra-filtration standards, improving reliability and ease of use at lower costs. Innovations in mixing allow for faster solid separation, reducing retention time and achieving a 35% decrease in tankage and membrane expenses. With a high flux rate operating at under 1 bar, it reduces energy consumption by over 90% and maintains full flux restoration in pilot tests

Electrocoagulation

A.H. Lundberg Systems Limited® is partnering with electrocoagulation vendors to solve the wastewater treatment challenges faced by the oil & gas industry.

Electrocoagulation can economically-effectively remove contaminants such as suspended oil and grease, silica, calcium, magnesium, heavy metals, and suspended solids from waste streams with an efficiency rate of 90-99%.

System Benefits:

Electrocoagulation effectively treats contaminated water by removing silica, calcium, and toxic elements without expensive chemicals, achieving 90%-99% removal efficiency. This method operates at a low power cost of 4 to 7 kWh per 1,000 gallons and requires minimal manpower, making it a cost effective solution for wastewater management.

FOUL CONDENSATE STRIPPING

AHLS advanced and well-engineered Foul Condensate Stripping Column Systems will:

◊ Remove these odorous contaminants from selected Foul Condensate streams from the digester and evaporator areas. This process is critical for off-loading the effluent treatment system and keeping the mill in compliance with environmental permits and regulations

◊ Recover the valuable heat used for stripping in a manner that meets the mill's integrated energy recovery objectives. This heat is recovered in the reflux condenser by producing steam, heating boiler feed water, or heating black liquor

◊ Produce stripper off-gas (SOG) and subsequent crude methanol of a consistent quality for feed to a methanol purification system or for disposal by incineration, and

◊ Produce stripped condensate of a consistent quality for re-use in the mill. Typical uses include brown stock washing and lime mud washing

Condensate Stripping Column System Includes the following:

- Feed tank
- Fibre filter
- Condensate preheater
- Stripping column with stripping and rectification sections
- Reflux condenser

The Foul Condensate Stripping System may be designed to use structured packing, random packing, or tray systems. Optional enhancements to the Foul Condensate Stripping System can include the selective condensation and storage of crude liquid methanol from the stripper off-gas for use as an auxiliary fuel.

Chemical Production Systems

SULPHUR BURNER SYSTEMS

A.H. Lundberg Systems Limited® can design, and provide a variety of advanced Sulphur Burner Systems that are more cost-effective, incinerate elemental sulphur to generate sulphur dioxide (SO_2). The SO_2 is then used in many industries, such as pulp and paper, mining, wet corn milling, food industry, and water treatment industry. In the gold mining industry, sulphur dioxide is utilized to destroy the residual cyanide in the detox tank.

Reaction: $CN^- + SO_2 + O_2 + H_2O \rightarrow OCN^- + SO_4^{2-} + 2H^+$

Designed and built to meet your needs

AHLS Sulphur Burner System design capacity ranges from 1 to 100T per day of burned sulphur. Larger capacity is available. The sulphur burners are fed with molten sulphur. The system can be designed to operate at near atmospheric, or higher discharge pressure.

The sulphur burner nozzle is designed to use air atomization of the molten sulphur. This provides a wide turn-down ratio, without degradation of sulphur dioxide concentration in the product gas. Sulphur trioxide generation is minimized by maintaining operating temperatures above 1400°C with optimized air/fuel ratio controls.

Our Sulphur Burner Systems can be delivered fully automated and as completely furnished modules, which include interconnecting piping, instrumentation, manual and control valves, air compressors and combustion air drying systems to meet the gas composition and the discharge pressure.

Optional design considerations:

To pre-heat the burner chamber on system start-up, an auxiliary fuel burner with fuel train and burner management system can be included for ease of operation.

A direct contact hot gas quencher using spray water can be added to cool the exhaust gas.

If lower exit temperatures are required, an additional indirect shell and tube heat exchanger may be included to further sub-cool the product gas.

For larger sulphur burners or where energy recovery is desired, waste heat boilers are available. This allows the production of steam from the heat generated by the incineration process for use in the plant or generating electricity.

If liquid SO_2 is desired, AHLS can include this in the supply.

Simplicity

The system is designed with automatic controls to operate with minimal operator attention.

Performance

The system has a high concentration of sulphur dioxide (18%v/v dry) to prevent sulphuric acid formation in the system and minimize corrosion. The gas can be used for generating other sulphur-based products, such as SBS, ABS, KS, and SMBS with minimal contamination.

Advantages

◊ Wide range of design capacity available
◊ Fast start-up
◊ High turn-down ratio
◊ Available as modular system

Durability

The sulphur burner is constructed of stainless steel internals, with the quench vessel made from corrosion-resistant Hastelloy 2000-C. There is minimal use of carbon steel and only for the stair tower, and access platforms.

Longevity

The system is designed for variable operation with spall-resistant refractory. The quench vessel is designed to resist sulphuric acid corrosion as the gas is cooled leaving the sulphur burner.

Uses in Industry

◊ Cyanide destruction
◊ Generating sulphuric acid or other compounds that contain sulphur
◊ In-house SO_2 generation
◊ STEEP water generation in the Corn Plants

WHITE LIQUOR OXIDATION SYSTEMS

AHLS supplies two types of White Liquor Oxidation Systems to generate a caustic substitute.

◊ Our patented "Air Oxidation System" gives results with very low residual sulphide content. Our "Oxygen System" is provided as a fully modular unit, complete with all necessary piping and instrumentation, ready for easy connection to the mill's existing infrastructure

◊ Both systems ensure the efficient oxidation of sodium sulphide to sodium thiosulphate

The two types of systems used for white liquor oxidation include the tubular plug flow reactor (PFR) for oxygen and the continuous stirred tank reactor (CSTR) for air. In a PFR, reactants travel through the piping as they are consumed along the length of the vessel whereas in the CSTR, reactants are fed to a vessel where they are continually agitated to induce mixing.

PFRs are able to achieve higher conversions than a CSTR of the same volume/residence, as a result of dilution with the bulk fluid. To achieve the same outlet conditions, a CSTR will have to be larger to allow enough reaction time. By using piping 50mm or less in the PFR, high turbulence and velocities guarantee sufficient mixing throughout the reactor. Conversely, in a CSTR the agitation from air sparging is used to provide this mixing.

Typical CSTRs used in white liquor oxidation have a longer residence time/volume than PFRs which allows them to achieve slightly higher Na_2S conversion efficiencies, but this is at the expense of higher oxygen consumption and lower caustic concentration in the oxidized white liquor. The increased residence time in the CSTR allows the second reaction to continue which in turn consumes these desirable components while oxygen remains in the system. Due to the loss of oxygen in the second reaction, it is necessary to have a higher O_2 feed rate to ensure adequate Na_2S conversion.

Reactions:

$2\ Na_2S + 2O_2 + H_20 \rightarrow Na_2S_2O_3 + 2\ NaOH$

$2\ Na_2SO_3 + O_2 \rightarrow 2\ Na_2SO_4$

AMMONIUM BISULPHITE (ABS) ABSORPTION SYSTEMS

Sodium Bisulphite (SBS)

Similar to ABS, sodium bisulphite absorption reaction is optimized when the pH is controlled to 4.5

Ammonium Bisulphite (ABS)

Ammonium bisulphite pH control is particularly critical since at pH > 4.5 gaseous ammonia ($NH_{3(g)}$) vapor pressure increases significantly. At lower pH, with sufficient mass transfer surface area the NH_3 concentration in the column outlet can be reduced in order to meet the emission requirements of the proposal request. Since the solubility of $NH_{3(g)}$ in water is improved at low temperature, heat removal in the circulating loop is provided to maintain a column temperature of < 32°C.

Potassium Sulphite (KS)

The Potassium sulphite primary absorber tower is not an acidic column since it operates at a pH > 9.0. At this pH the sulphite reaction is very fast and the outlet gas is essentially free of SO_2.

Sulphur dioxide (SO_2), scrubbing systems collect gases containing SO_2 emissions such as flue gas from thermal oxidizers or sulphur burners by liquid scrubbing in absorption towers.

Alkali reagents such as ammonia, caustic soda, soda ash, and potash can react with the SO_2 gas in water to form the bisulphite or sulphite product.

Conversion of $SO_{2(g)}$ to $SO_3^{-2}{}_{(aq)}$ in an alkali scrubber at pH > 7.0 occurs rapidly, allowing absorption units to easily achieve > 99.9% SO_2 removal efficiencies.

Absorption of $SO_{2(g)}$ to sodium bisulphite at pH 4.0 is a slower reaction. To achieve the required mass transfer, increased contact area is required resulting in a larger packing section.

Production of bisulphite is optimized according to the above criteria under acidic conditions. Since at low pH there remains a significant amount of free SO_2 in the circulating liquid, multi stage absorption columns are required to complete the SO_2 absorption process.

The ABS and SBS primary column outlet gases can contain up to 2.0% residual $SO_{2(g)}$, further treatment is required in order to collect the residual SO_2 emissions and optimize sulphur yield. A two-stage tower with FRP packing is added. Each packed section will include a dedicated recirculation pump, sodium carbonate reagent feed system and a demineralized water. Individual pH, density measurement, and control systems are required as well.

EVAPORATORS

A. H. Lundberg Systems Limited® is experienced with process liquids systems from pre-evaporators to concentrates and crystallizers with high product solids. We have the expertise to deliver the best possible solutions.

Pre-Evaporation System

Utilizing low-level waste heat, pre-evaporation systems evaporate weak liquor and strip TRS, and VOCs from the condensate before the main evaporator train.

MVR Evaporators

AHLS provides, falling film evaporators with mechanical vapour re-compression (MVR) for situations where low-pressure steam is not continuously available. These evaporators re-compress and reuse the steam produced from the liquor itself as the heat source. “Starting steam” is required initially but can be discontinued once the system stabilizes. MVR evaporators feature high-efficiency mist eliminators and are constructed from materials like 316L stainless steel, high nickel austenitic stainless steels, duplex stainless steels, and high Moly steel. Other materials are available upon request.

Multiple Effect Evaporators

When plant steam is available, AHLS offers multiple effect evaporator systems, ideal for industries such as pulp & paper, ethanol production, ethylene glycol concentration, and sugar refining. These systems improve steam efficiency with more effects, balancing capital and operating costs. They operate at a lower electrical load compared to single effect MVR evaporators and can be designed as Falling Film, Rising Film (Long Tube Vertical), or Flooded Forced Circulation.

Our innovative designs include:

- Tubular design for reduced maintenance
- Positive non-condensable gas venting
- Innovative condensate segregation
- High efficiency entrainment separators to reduce chemical carry-over and provide clean distillate
- Foam control
- Integration of condensate stripping systems

CONCENTRATORS

Concentrators

The development of black liquor crystallizers in the late 1960s and 1970s addressed the challenges of processing complex liquors from materials like Bagasse and Bamboo, which have high inorganic-to-organic ratios and low residual active alkali. For three decades, forced circulation crystallizers were the main solution but required significant operational power due to challenges with supersaturation and viscosity. Recent innovations, particularly the Reynolds Enhanced Crystallizer (REX), have improved heat transfer efficiency with spiral rib-type inserts, significantly lowering power consumption to 40-45% of traditional systems. Currently, over many forced circulation crystallizers operate worldwide, with some using REX technology, which enhances throughput, product quality, and efficiency while minimizing scale formation and costs.

Surface Condenser and Vacuum System

The surface condenser is a vertical shell and tube unit designed to condense evaporating vapors efficiently, featuring an external bustle for uniform distribution. It includes a pre-cooling section that separates condensates and vents incondensable, along with a dam for collecting foul condensate directed to a seal tank. Key design attributes include large windows for optimal vapor velocity, a specially aligned NCG passage, and a unique snowflake-patterned tube sheet to minimize pressure drop. Additional features include vibration analysis, cross baffles, standard 1-inch diameter tubes, and integral sight-glasses for monitoring condensate quality. The vacuum system consists of a two-stage steam ejector system with shell-and-tube inter and after-coolers and a pre-assembled start-up ejector.

Our innovative designs include:

- Evaporators and Concentrators for the Pulp & Paper, Corn, and Sugar Refining industries
- Crystallizers for salt recovery in the industries
- Purification of contaminated water by evaporation from boiler blow-down in the oil & gas industry
- Recovery of water from Produced Water or reused in the SAGD plant

Chemical By-Product Recovery Systems

METHANOL PURIFICATION SYSTEMS

A.H. Lundberg Systems Limited® patented Methanol Purification System provides energy savings and environmental benefits to Pulp & Paper industry remediating effluent streams containing methanol.

The AHLS Methanol Recovery and Purification System produces the following streams from kraft pulp mill foul process condensates, that generates:

◊ Commercially purchased methanol is rated equally to high purity methanol

◊ High quality stripped water

As separate products, both the recovered methanol and the stripped condensate contribute operational and economic value to the plant.

Benefits of installing the methanol system:

- Modular construction for reduced the construction time and lower CapEx
- High turn-down ratio
- Bio MeOH product commands premium price in the Market
- Design flexibility to meet Customer requirements
- Choice for just upgrading the methanol for incineration
- As a commodity, the MeOH is worth five times more, then using it to replace fossil fuel

METHANOL RECOVERY PROCESS

Methanol is produced as a by-product of the kraft pulping process. A large fraction of this methanol is recovered in the foul condensate steam stripping system. The SOG is condensed to produce a coarse methanol solution, containing about 50% methanol, which is than upgraded to a minimum of 99.85 weight percentage in the methanol purification system. Methanol purification is based on the unit operation of distillation, including these three separate stages.

In the first “topping” stage, the compounds are more dangerous and unstable, such as Hydrogen Sulfide and ammonia, which are removed in the vapour phase while the methanol, water and other less volatile compounds remain in the bottom.

In the second “rectification” stage, the purified methanol is recovered near the top of the column while water and other temperate compounds are removed from the bottom.

The third and final “polishing” stage removes any remaining contaminants. Finally, a finished product of methanol (MeOH) is produced. This final stage of purification is invaluable to the result and optimal replacement for fossil fuels.

The benefits of methanol recovery are:

- Reusing stripped condensate reduces plant makeup water requirements
- Reducing the overall water load to the downstream treating facilities
- Recovered methanol can be used for generating chlorine dioxide
- Surplus methanol can be recovered as a commercial bio product for sale or incinerated to displace fossil fuels

Methanol Purification Systems are designed in modular skids and delivered for an optimal footprint to reduced installation time.

The recovered methanol will meet commercial grade purity of >99.85 wt%.

BIODIESEL

Innovative Bio-Refinery Process

A.H. Lundberg Systems Limited® introduces a cutting-edge biodiesel production process, designed for integration into Kraft pulp mills. Utilizing crude soap and crude stripper off-gas (SOG), this disruptive method converts soap into biodiesel and purifies methanol through patented processes. While lab-scale success has been proven, pilot and industrial-scale plants are yet to be built. Proven methanol purification installations exist in Alberta and Germany. Early commercial installations may qualify for subsidies.

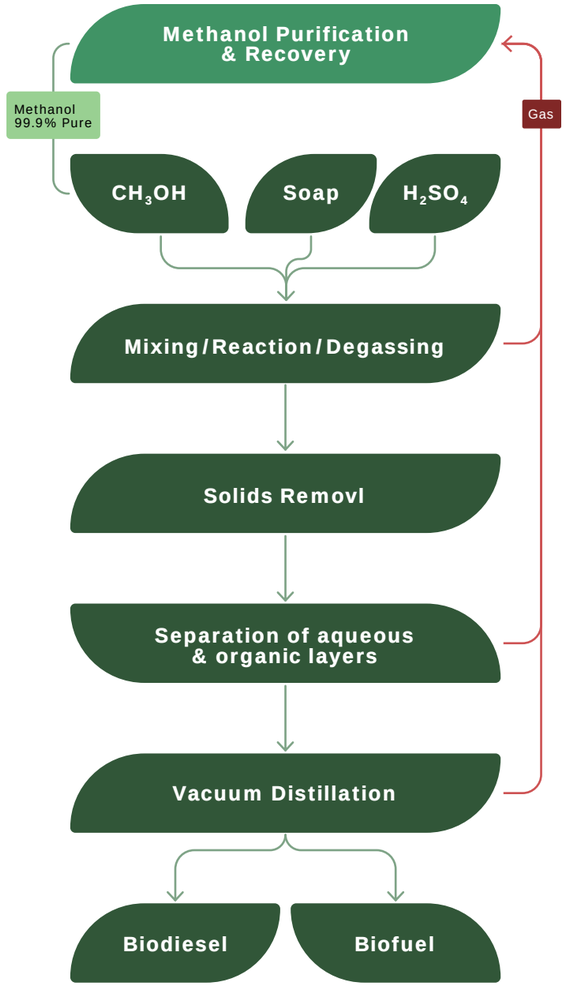
Soap and Methanol By-Products

In Kraft softwood pulping, soap is skimmed from black liquor and typically burned or converted into tall oil. Methanol is captured from the digester and evaporator areas, concentrated to about 40% in the stripper off gas, and refined through a three-stage distillation process.

Biodiesel Conversion Process

Soap is mixed with methanol and acidified with sulphuric acid. Sodium sulphate and fiber are filtered and returned to the liquor system. The process includes several distillations, producing purified biodiesel and a natural gas substitute. Biodiesel can be blended with petroleum diesel for on-site use or local market sales. Remaining biofuel displaces natural gas in the lime kiln or power boiler and contains valuable sterols.

Explore the future of biodiesel production with our advanced chemical systems.



Ideal Mill Profiles:

- High production Kraft mills processing softwoods.
- Mills with higher soap yields.
- Mills with existing soap skimming and handling systems.
- Mills with condensate segregation, stripping, CNCG, SOG, and turpentine systems.
- Recovery-limited mills struggling with soap disposal.
- Mills facing high diesel and methanol costs.
- Mills located near sterol refiners.

TURPENTINE RECOVERY

AHLS utilizes a 2-stage condensing system to optimize turpentine recovery, reduce stripping steam requirement and increase turpentine decanter efficiency.

It includes a pressure vacuum relief valve, a cyclone entrainment separator, two condensers, an indirect vent gas cooler, a horizontal flooded decanter with weir box, and a flooded horizontal storage tank.

The cyclone separator removes both fiber and entrained black liquor, since the black liquor may cause emulsification of the condensate in the decanter.

The primary condenser liquefies mostly water with some methanol, while the second stage condenser liquefies the blow-through containing turpentine from the primary condenser.

The condensers are arranged as vertical shell units with the foul vapours condensing in the tubes for ease of cleaning, if necessary.

AHLS Turpentine Recovery System Specific Design Features

The use of two condensers in series has several benefits over a single condenser:

- Produces high grade clean hot water.
- Produces contaminated hot water for re-use.
- Increased decanter efficiency.
- Reduced turpentine losses.
- Reduced Foul Condensate Stripping (FCS) steam requirements.

SOAP AND FOAM HANDLING

Reasons to Remove Soap from Weak Black Liquor Storage Tanks

◊ Soap acts as a surfactant that stabilizes foams and increases evaporator liquor carryover.
◊ At weak black liquor (WBL) solids levels greater than 14%, soap accumulates rapidly, reducing weak liquor storage significantly.
◊ Weak liquor skimming increases soap removal which results in a reduced load on the evaporator soap skimmers.
◊ Soap can be collected and refined into Crude Tall Oil (CTO) and Distilled Tall Oil (DTO) along with other high value bio-products.

Foam liquor carryover will occur if the height of a column of foam is taller than the height of the vapor space in the evaporator.

$$\text{Foam Height} = \frac{\text{Volumetric Evap. Rate* Bubble Life}}{\text{Foam Column Area}}$$

◊ The bubble life is increased by lower temperatures, with characteristics of smaller bubble diameter and increased soap content.
◊ Removal of the soap before evaporation will reduce the bubble life and reduce liquor carryover.

Summary:

- Tall oil soap is a mixture of the sodium salts of rosin acids & fatty acids that separates from black liquor.
- Produces contaminated hot water for re-use.
- Depending on wood species, soap recovery generation varies.
- Good soap recovery reduces evaporator fouling, recovery boiler loading & effluent toxicity, and reduced stripping steam requirements.
- Soap solubility is minimized at 30% black liquor solids and 6 -10 g/l residual effective alkali.
- Soap separates in the washer filtrate tanks, weak liquor storage, evaporator soap skimmers.
- Soap is best removed in tanks that are well baffled and have stable level control.
- Improve soap skimming by isolating the inlet and outlet liquor, and controlling the soap bed height.

SOAP TO CRUDE TALL OIL

Efficient Soap Separation and Skimming

The AHLS separator reduces the black liquor content in soap from 20% to 5%. For instance, 100 tons of liquor-soap mixture at 20% has 20 tons of soap. Installing AHLS Soap Separator reduces this to 5%. This reduction is significant if the tall oil is shipped to an off-site processing plant.

Our advanced skim tanks use a specialized skimming mechanism to continuously remove the tall oil soap that rises to the tank's surface. Internal baffling ensures uniform liquor distribution and minimizes channeling, optimizing the recovery process.

Enhanced Separation with Aeration

Aeration improves soap separation by introducing a small amount of mill air into the discharge line of the skim tank feed pump. This reduces soap density through frothing, enhancing separation.

Optimized Storage with Soap Concentrators

Our soap concentrators increase soap density, reducing storage needs while maintaining high soap quality. Precision-Controlled Rake Mechanism The soap rake mechanism, supported by a bridge and centered by an internal bearing, ensures precise operation. Depth control of the soap layer is managed by an adjustable weir-equipped standpipe.

Maximizing Tall Oil Recovery from Soap – an Essential Byproduct

Tall oil, a valuable byproduct of the kraft pulp industry, is derived from the resin and fatty acids in pine trees. During alkaline pulping, these acids are neutralized by caustic soda, forming soaps that rise to the surface of the black liquor for collection.

Optimal Tank Placement

Placing the drainage tank close to the soap storage tank is advantageous because it significantly increases soap viscosity (10 to 14 times) upon liquor removal. This proximity ensures efficient transfer to the tall oil acidulation plant or loading facilities.

Maximize tall oil recovery with our state-of the- art Soap Separator technology, designed for enhanced efficiency and reliability.

AHLS floating soap skimmer benefits:

- Variable skimming capacity
- Ability to skim soap at different levels
- The skimmer is lightweight for ease of installation
- Can be fabricated from different materials to suit the application
- Designed to rest on the floor when the system is empty
- The buoyancy chambers are ballasted to match the specific gravity of the fluid
- The hose is chemically resistant to soap and WBL
- The hose is suitable for high-temperature operation.
- The system can be easily removed for maintenance and replacement
- Less chemical consumption in the CTO plant
- CTO easily separates in the storage tanks

Heat Recovery Systems

In all cases, knowledge of the specific processes and heat transfer is necessary to ensure reliable and cost-effective energy savings. In addition, lessons learned in one industry have generated suitable solutions in other industries. For each heat exchanger application, AHLS works with the client to achieve the most cost-effective configuration and process effective solution.

As the industry becomes increasingly energy conscious, opportunities exist to recover energy from hot flue gases vented to atmosphere.

AHLS offers reboilers to recover heat from hot vent gases and generate clean steam for use in the mill. Clean steam reboilers include integrated inlet cyclone scrubbers to remove particulate matter, fiber and aerosols that may be in the vent gas.

A vent condenser is included to preheat boiler feed water. Thermal efficiencies of 93%+ are achieved.

AHLS also offers Air to Steam heat exchangers to preheat inlet air for flash dryers.

Benefits of a Flash Dryer Heat Recovery system include:

- Pre-heat inlet air to reduce flash dryer natural gas consumption
- Condensates can be recycled back to process
- Recovered fibres can be recycled to offload effluent treatment and fibre loss
- Easy to clean fin cooler design

Heat Transfer Systems

A.H. Lundberg Systems designs and supplies specialty shell and tube heat exchangers, direct contact condensers, surface condensers, hot gas quenchers, waste gas heaters and coolers, and vent gas heat recovery systems.

AHLS has specific experience in the design and supply of heat exchangers and heat recovery systems for the following applications:

- Kraft Pulp and Paper Mills
- TMP Pulp & Paper Mills
- Dissolving Pulp Mills
- Soda Pulp Mills
- Mining and Mineral Processing
- Oil and Gas Operations
- Corn Plants

Heat Transfer Systems typically require working with contaminated low-pressure steam, gases, and liquids that may be toxic, corrosive, or severely fouling solids.

Experience and expertise in dealing with these types of contaminants is integral to the successful recovery of energy from process streams.

Keeping equipment costs down, especially when the metallurgies required are exotic, is essential.

Our expertise in shell & tube heat exchangers includes heavy liquor heaters, digester recirculating liquor heaters, and chlorine dioxide solution heaters for the kraft pulp industry.

We also have many references for hot gas quenchers, direct contact condensers, heat recovery, heat exchanger, and surface condensers for other industries.

Custom System Components

DESIGNS AND SUPPLIES FOR VARIOUS APPLICATIONS.


Cyclone Separator


Phase Separator


Strainers


Pressure Relief Valve

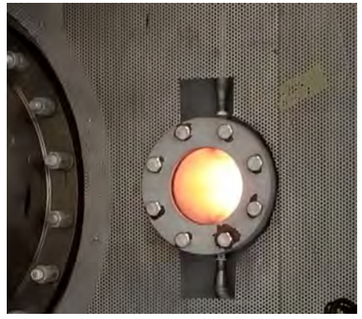

Rupture Disk


Sulphur Filter

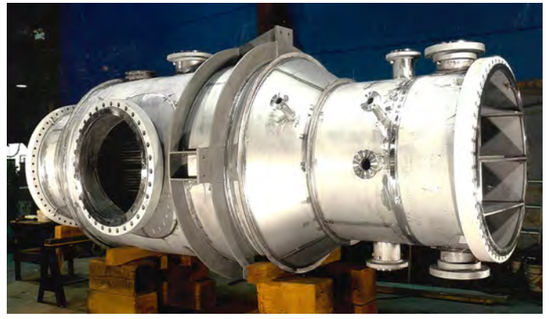

Foul Drain Seal Tank

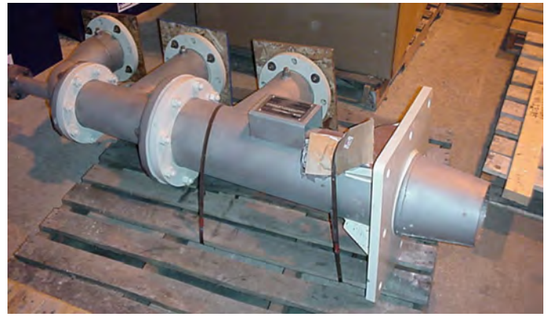

Sulphur Melter & Molten Tanks


Steam Ejector


Sight Glass


Mist Eliminator


Specialty Pressure Vessel


Injection Nozzle


WLOX Reactor


Waste Heat Boiler

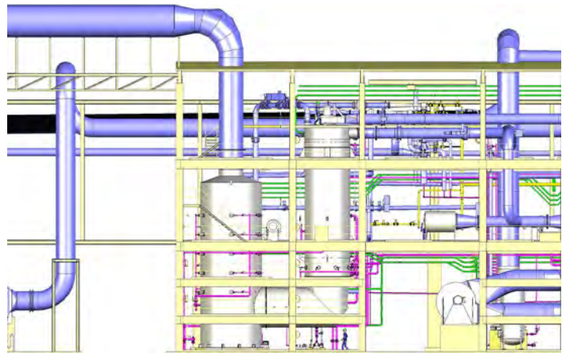

Flame Arrester

Basic and Detailed Engineering

Basic Engineering and Equipment

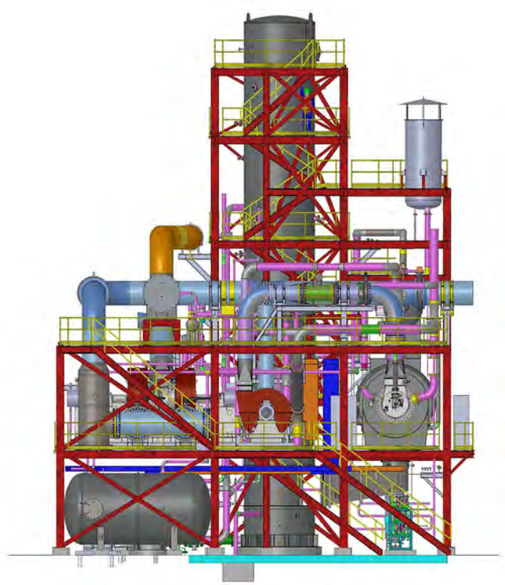
Discover unparalleled performance and reliability with our premier equipment supply. Meticulously designed and fabricated equipment includes state-of-the-art features to meet customer's most rigorous environmental regulations, energy conservation & performance demands.

From simple tanks to complex columns, skid mounted to stand alone, customers are assured of efficiency, accuracy, durability, and low maintenance/ high value. Backed by exceptional customer support and a commitment to quality, our equipment empowers your team to tackle complex challenges and achieve outstanding results; in some cases, using patented or in-house proprietary designs.



Detailed Engineering

These services contribute to the meticulous planning, design, and execution of projects, ensuring not only standards are met but that there is precision throughout the project's engineering life-cycle.



AHLS Basic Engineering:

- Feasibility Studies
- Conceptual Design
- Preliminary Engineering/ Evaluation of Technical and Economic Feasibility
- Regulatory Compliance
- Cost Estimation
- Risk Assessment

AHLS Detailed Engineering:

- Detailed Design and Elaboration 2D/3D Design Development
- Process Flow Diagrams (PFD) and Piping & Instrumentation Diagrams (P&ID)
- Equipment Specifications and Sizing
- Process Engineering
- Mechanical Engineering
- Instrumentation Engineering
- Controls Engineering
- Electrical Engineering
- Materials Engineering
- Civil Engineering
- Structural Engineering
- Material Selection and Procurement Support:
- Instrumentation and Control Systems
- Cost Estimation and Budgeting
- Quality Assurance and Control
- Commissioning and Start-up Support

Project Delivery Models

System Modularization

Recently, AHLS have supplied many systems utilizing Modular Process Skids. All process equipment, piping, control valves and instruments are all pre-assembled in the fabrication shop to save valuable installation time and resources on-site during construction.

The modular skids allow the process system to be easily transported.

Traditional stick-built construction requires system parts to be shipped individually and installed incrementally on site.

Modular skids provide several advantages including:

◊ Designed to build within frames for easy transportation
◊ Instruments are in optimized locations to reduce carbon footprint
◊ Assembly is built in controlled fabrication facilities
◊ Factory Acceptance Testing (FAT) tested prior to shipping
◊ Designed for accessibility
◊ Improved construction time
◊ Reduced start-up time
◊ Reduced Capital Cost

Engineering, Procurement and Construction (EPC):

◊ Projects ranging from small-scale tasks, to larger comprehensive evaporation system installations
◊ All major systems designed for turnkey installation
◊ Utilization of existing plant specifications, supplemented by new and improved specifications generated for plant improvement when necessary
◊ Integration of plant-preferred equipment and suppliers
◊ Collaboration with local vendors supporting plant operations

Sample of Projects

China

Pulp Mill Air Pollution Odour Control Systems

Seven major projects with systems to collect pulp mill NCG gases generated during the cooking and evaporation processes. Incinerator islands include heat boilers, thermal, oxidizers, waste, and SO_2 scrubbers.

Brazil

Pulp Mill Air Pollution Odour Control Systems

EPS supply of CNCG and DNCG collection and incineration systems in recovery and power boilers with back up flare at the new dissolving pulp plant.

Indonesia

Pulp Mill Air Pollution Odour Control Systems

EPS supply of mill wide CNCG, SOG/methanol and DNCG system upgrades for a 7500 Air Dried Metric Tonnes Per Day (admtpd) Pulp Mill, including incineration and six recovery boilers.

Japan

Regenerative Catalytic Oxidizers

RCO system to treat volatile organic compounds from veneer dryers to destroy odours and reduce opacity.

Poland

Foul Condensate Stripping Systems

EPS supply of a foul condensate stripping system to a kraft pulp mill.

Turkey.

Foul Condensate Stripping System

Steam distillation column to remove contaminants from pulp mill effluent.

Australia

Wet Electrostatic Precipitator

Supplied five WESPs on an EPC basis to reduce opacity and particulate matter from a fibreglass insulation plant.

Germany

Methanol Purification System

Modular supply to recover and purify methanol from kraft mill foul condensate to 99.85% purity.

USA

Sulphur burner - SO_2 Production

Modular supply of 35 stpd sulphur burner with quench vessel and indirect contact secondary cooler, along with reactors for producing, sodium bisulphite, ammonium bisulphite, and potassium sulphite.

Norway

Sulphur burner - SO_2 Production and Purification

System with a 96 mtpd sulphur burner, a waste heat boiler, and an indirect contact secondary cooler. Purification using absorption and steam stripping process.

Thailand

Evaporator, CNCG and Stripping System

EPS supply of stripping system upgrade with CNCG and liquid methanol recovery boiler incineration system.

Canada

Distillation Column

AHL designed and built a modular, tailor-made distillation system that separated two solvents so they could be reused in a plastic recycling process.

Technical Services

1. Studies and Cost Estimates
At AHLS, our unmatched engineering studies and cost estimates are driven by our comprehensive analysis, experienced team, innovative technologies, client-centric focus, proven track record, and cost-effective solutions, ensuring precision, innovation, and client satisfaction in every project.

2. Aftermarket Audits
AHLS audits its existing plant systems for a number of purposes, including increasing system capacity, system safety, optimizing efficiency, improving stability, ease of operation, troubleshooting, and interfacing one system with another, or with a future system. Each audit is tailored to the specific needs of the client. Our specialty is the process knowledge of the technologies we provide.

3. System Upgrades and Modernization
Enhance your existing systems with the latest technology. Our engineers will work with you to identify opportunities for upgrades that improve efficiency, productivity, and sustainability.

4. Emergency Repair Services
Rapid response teams are on standby to address any unexpected breakdowns. Our goal is to minimize downtime and get your equipment back up and running as quickly as possible.

5. Replacement Spare Parts and Inventory Management
Guaranteed availability of genuine (O.E.M.) spare parts and components. We offer efficient inventory management solutions, so you always have the critical parts you need on hand.

6. Preventive Maintenance
Proactive maintenance schedules tailored to your specific equipment needs. Our team conducts regular inspections, routine maintenance, and performance checks to prevent issues before they arise.

7. Technical Support
Access to our dedicated technical support team around the clock. Whether you have a minor query or a major issue, our experts are ready to assist you anytime, ensuring minimal disruption to your operations.

8. Training and Development
Empower your staff with the knowledge and skills they need to operate and maintain your plant operations systems effectively. We offer comprehensive training programs tailored to your team's needs.

9. Commissioning Assistance
AHLS Commissioning Assistance ensures systems are tested and optimized for peak performance, with optional installation support. Comprehensive services minimize downtime and maximize efficiency from day one.

Global Representation and Alliances

Our Head Office and Global Representatives
The local agent will be pleased to provide further information about our products and services.

A.H. Lundberg Systems Limited®

Address 5118 Joyce St. Suite 300
Vancouver BC, Canada V5R 4H1

Phone +1 (604) 629-5599

Website www.ahlundberg.com

Email sales@ahlundberg.com
Use the QR code below to email us!

5118 Joyce St. Suite 300
Vancouver BC
V5R 4H1 Canada
+1 (604) 629-5599
ahlundberg.com
sales@ahlundberg.com