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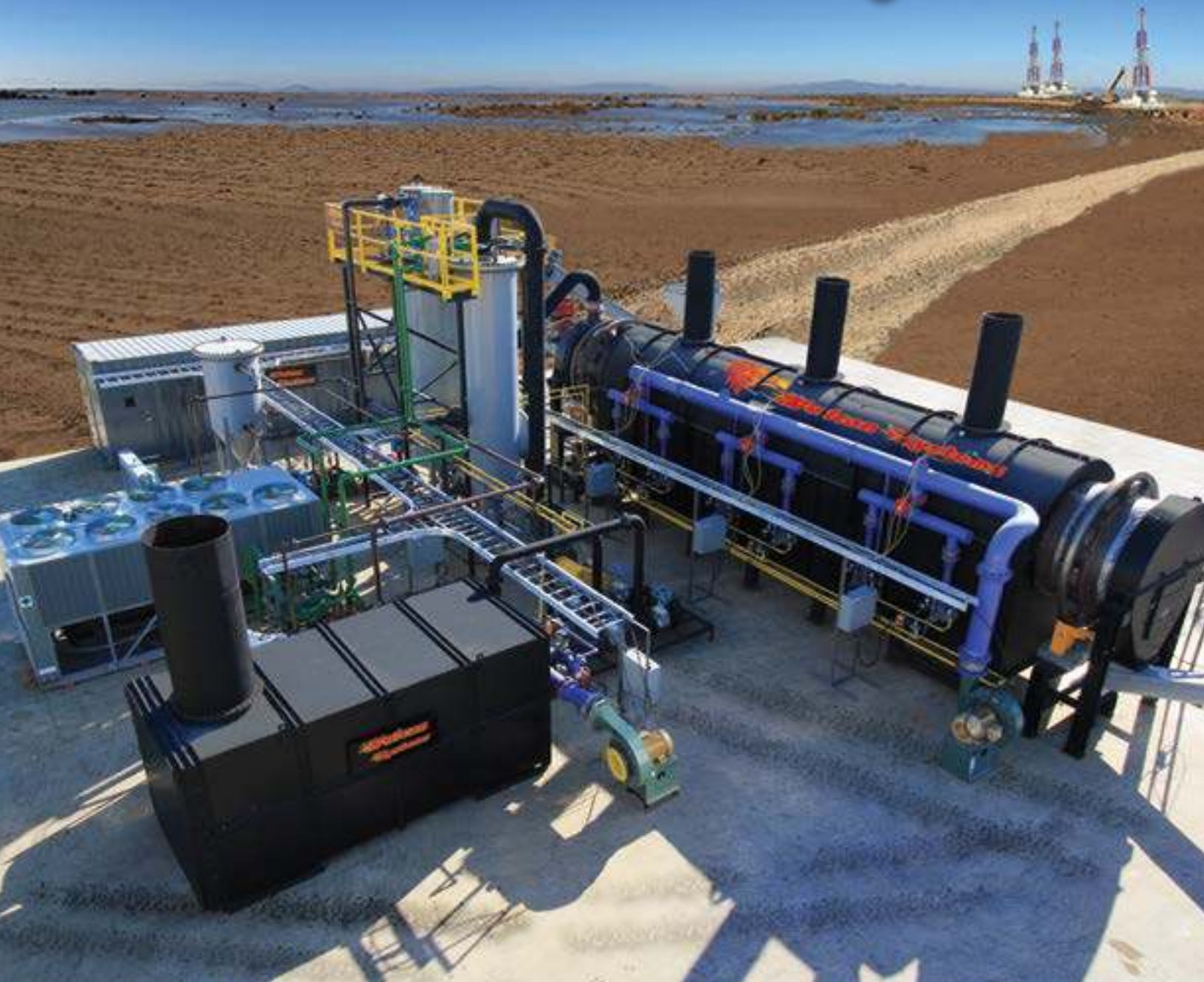
Cover Story:

Vulcan Systems

The Remediation of Drilling Waste



VULCAN THERMAL DESORPTION UNIT

Vulcan® Systems provides custom-built thermal desorption solutions for the remediation of drilling wastes, petroleum-contaminated soils and a variety of other materials. The Vulcan® Indirect Fired Thermal Desorption Unit can be custom-designed and manufactured to provide a thermal solution for numerous environmental issues, including drill cuttings, drilling muds, and soil remediation. This indirect fired system thoroughly processes and remediates drilling wastes and soils contaminated with petroleum hydrocarbons. With our engineering design, set-up and commissioning support and aftersales services, Vulcan® Systems offers comprehensive thermal solutions to meet each client's individual project needs.

LEADING THE WAY IN THERMAL DESORPTION TECHNOLOGY

A Vulcan® Systems Thermal Desorption Unit that was recently shipped to Argentina

DRILLING WASTES: RECOVERY AND BENEFICIAL REUSE

While the oil and gas industry may fluctuate, the presence of drilling waste remains consistent—as does the need to dispose of that waste. Operators are often on the lookout for innovative ways to handle, treat and even reuse waste from oil and natural gas drilling processes.

Drilling mud, also known as drilling fluid, is one of these common wastes and an essential component of the drilling process. In oil and gas drilling operations, drilling muds are used to control subsurface pressures, lubricate the drill bit, stabilize the well bore and transport drill cuttings to the surface.

During the oil and gas drilling process, boreholes are created in the earth. These holes are drilled for the extraction of oil and gas, as well as for core sampling and other purposes. Drilling mud aids in the borehole drilling process by acting as lubricant for the drill bit while also transporting drill cuttings—another form of drilling waste—to the surface. Drill cuttings are broken pieces of solid material that are created as the drill bit penetrates and breaks the rock. As the drilling mud circulates up from the drill bit, it carries the drill cuttings up to the surface, where the mud and cuttings must be separated before recovery.

"DRILL CUTTINGS AND DRILLING MUDS CAN BE TREATED FOR BENEFICIAL REUSE."

Thermal treatment presents operators with the opportunity to remediate and reuse drilling wastes. With the use of a thermal desorption unit, drill cuttings and drilling muds can be treated for beneficial reuse.

TYPES OF DRILLING MUDS

Depending on the application, one of three types of drilling muds may be used: water-based muds (WBMs), oil-based muds (OBMs) or synthetic-based muds (SBMs). Oil-based muds are one of the most effective drilling fluids, but many wells, especially in the southern gas basin of the North Sea, are drilled with water-based muds. Synthetic-based muds have a lower environmental impact and biodegrade more quickly, making SBMs one of the more frequently used types of drilling fluids.

Water-based muds are produced with water mixed with clays and other chemicals to create a homogenous blend. WBMs generally consist of bentonite clay with additives such as barium sulfate, calcium carbonate or hematite. Thickeners, such as xanthan gum, glycol and starch, may also be used to influence the mud's viscosity.

Oil-based muds have a base fluid consisting of a petroleum product like diesel fuel. Because of their increased lubricity, enhanced shale inhibition and greater cleaning abilities, OBMs are more frequently used than WBMs. OBMs are also able to withstand greater heat without breaking down.

Synthetic-based muds possess a base fluid of synthetic oil. These muds are most frequently used on offshore rigs because they have the same properties as OBMs but a toxicity of fluid fumes that is significantly lower.

DRILLING WASTE DISPOSAL AND RECOVERY

After the drilling job is complete, the drilling wastes must be disposed of in some way. The U.S. Environmental Protection Agency (EPA) classifies drilling fluids as "special waste," meaning that they are exempt from many federal regulations. Because of this classification, laws governing the disposal of drilling muds vary from state to state. In California, for example, the state government has a strict set of regulations for drilling wastes and requires operators to obtain approval before they may begin any type of disposal. In 2012, an oil company in Texas had to pay a $1.35 million fine after drilling waste that was placed on their "landfarm" contaminated nearby water sources. Landfarms are privately-owned, state-regulated fields where drilling waste is spread, and while they are legal, they are capable of causing damage to the surrounding environment. Drilling waste, even when buried, can easily contaminate soil and groundwater when the hydrocarbons and other chemicals leach into the earth.

While most water-based muds are disposed of when the drilling job is completed, many oil-based and synthetic-based muds can actually be recycled. Drill cuttings can also be recycled and reused, after the hydrocarbons are removed.

On a standard drilling rig, there are a variety of relatively simple processes that can be used to capture clean mud that would otherwise be discarded and put it to beneficial reuse. Throughout the drilling process, for example, drilling fluids are recirculated, which aids in decreasing waste by reusing as much mud as possible. Even the recovery of drilling fluids during tank cleaning may present an opportunity for reuse.

Drilling mud transports the drill cuttings back to the surface in order to prevent the well from clogging. On the drilling rig, the cuttings are separated from the mud, and the mud is recycled for reuse. The drill cuttings, meanwhile, are either discharged to the seabed, re-injected into the well or taken ashore for treatment and disposal. These cuttings vary in size and texture, depending on the type of rock and drill used. Drill cuttings can range in size from fine sand to gravel.

While drill cuttings are often disposed of after the drilling operation is finished, they can actually be treated and beneficially reused. Before drill cuttings can be reused, however, it is necessary to ensure that the hydrocarbon content, moisture content, salinity and clay content are suitable for the cuttings' intended use.

There are numerous applications for recycled drill cuttings, such as the stabilization of surfaces that are vulnerable to erosion, like roads and drilling pads. Oily drill cuttings can also serve the same function as traditional tar-and-chip road surfacing. Cuttings can also be used as aggregate or filler in concrete, brick or block manufacturing, as construction material or as daily cover at landfills. Recycled cuttings may also be used in the production of cement. Research has even been done on additional uses for recycled drill cuttings. There have been trials conducted in the United Kingdom to determine the feasibility of utilizing oily drill cuttings as fuel for power plants. In the U.S. the Department of Energy has researched the possibility of using drill cuttings as a substrate for restoring coastal wetlands.

VULCAN® THERMAL DESORPTION UNITS

The Vulcan® Indirect Fired Thermal Desorption Unit, as shown below, is a new 6' diameter x 35' long heated zone 304 stainless steel rotary kiln with combustion chamber. This system is specifically designed to remediate soils and drilling muds contaminated with petroleum hydrocarbons. Consisting of a primary treatment unit, quench scrubber, knock-out pot, oil/water separator, secondary treatment unit, air-cooled helical rotary liquid chiller induced draft fan, discharge system and control room. In the process, the drilling mud is transferred to the feed hopper of the Primary Treatment Unit (PTU) with the client's backhoe or skid loader. The material is then fed to a feed hopper mounted on a pugmill. From the pugmill, the material is transferred to the feed auger, which conveys the drilling mud into the PTU and maintains a seal/airlock for the system.

The indirect fired rotary kiln has three heat zones, and the operating temperature of the drum can reach up to 950 degrees Fahrenheit (510 Celsius). The rotary kiln is housed in a combustion chamber with six 2.7 MMBtu/hour burners, producing a total of 16.2 MMBtu/hour of heat. The kiln operates in an oxygen-deficient and slightly negative atmosphere. Vapors from the contaminated drilling muds are pulled out of the system in a countercurrent direction to the material flow. The vapor from the PTU is pulled into a high-efficiency quench scrubber that uses oil as the quench liquid. The quench operates at 250 degrees Fahrenheit (121 Celsius) and removes dust particulate, in addition to condensing the heavier hydrocarbons in the vapor stream. The condensed oil and sludge are pumped through a set of filters to an oil/water separator and then to an onsite storage tank (to be supplied by client).

The vapor that is not condensed in the quench scrubber is pulled through the knock-out pot, the custom-built vertical helical heat exchanger, which reduces the temperature to 70 degrees Fahrenheit (21 Celsius). The fluid from the knock-out pot—condensed water and oil—is pumped to an oil/water separator, then to a water and oil holding tank (to be supplied by client).

The non-condensable gases are pulled from the knock-out pot by an induced draft fan and pushed into the secondary treatment unit, where all remaining hydrocarbons are destroyed at temperatures of up to 2,000 degrees Fahrenheit (1,093 Celsius) with a residence time of up to two seconds.

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FINISHED PRODUCT

THERMAL TREATMENT OF DRILLING WASTES

The best method for unlocking all the potential uses of drilling wastes is through thermal treatment technologies, such as thermal desorption. Through the use of extremely high temperatures, thermal treatment reclaims or destroys hydrocarbon-contaminated materials, such as drilling wastes. Thermal processes are the most efficient treatment for destroying organics, capable of reducing the volume and mobility of inorganics like metals and salts. Waste streams that are particularly high in hydrocarbons, such as oil-based muds, are excellent candidates for thermal treatment.

Thermal treatment may be a short-term process to reduce toxicity and volume, as well as prepare waste materials for further treatment and disposal, or it may be a final treatment process, resulting in inert solids, water and recovered base fluids. Through the application of heat, thermal desorption vaporizes volatiles and semi-volatiles and easily removes light hydrocarbons and aromatics. The process produces a variety of secondary waste streams, including solids, water condensate and oil condensate.

Rotary kilns and hot oil processors are the most frequently used equipment and most proven methods for the thermal desorption of drilling wastes. Indirect fired rotary kilns use hot exhaust gases from fuel combustion to heat drilling muds and drill cuttings. This type of kiln consists of a rotating drum placed inside a jacket. Heat for the process is provided through the wall of the drum by the hot exhaust gas that flows between the jacket and the drum. The drilling wastes are transported through the drum as it rotates, and the treated solids are recirculated to prevent a layer of dried clay from forming inside the drum.

A vapor recovery unit can be used to recover or condense hydrocarbons from the gas stream extracted out of the thermal desorption unit. The hydrocarbons are not destroyed but may be reused in the process as an alternative fuel source or sold as a by-product. Vapor recovery units from Vulcan® Systems typically consist of a quench scrubber, mist eliminator, shell and tube heat exchanger, knock-out pot, oil/water separator and pre-combustion chamber. Depending on the process and material, optional items can be added to the process, including baghouses, thermal oxidizers or acid scrubbers. Vulcan® Systems is able to offer estimates to design a vapor recovery unit to suit specific applications, as well as to meet environmental and emissions standards.

Vulcan SYSTEMS

CAPTURING MERCURY EMISSIONS

Industrial processes that use mercury, waste generators and mineral mining operations all contribute to mercury pollution. Poor management of emissions or leakage can result in concentrations of mercury in the soil that are well above the regulatory limits. In 2007, the EPA reported that mercury was a "contaminant of concern" at nearly 300 Superfund sites across the country. As a result, the EPA and other organizations around the globe have tightened regulations on emissions of hazardous chemicals, such as mercury.

Fortunately, mercury can be cost-effectively removed from soil before it has a chance to negatively impact human health and the environment. Mercury can be removed from contaminated substrates through the use of thermal desorption. In this process, intense heat is applied to the material to volatize the mercury without damaging the material itself. In a thermal desorption unit, the contaminated soil is heated and the mercury is vaporized. A gas or vacuum system then transports the vaporized mercury and water to an air-emission treatment system.

Vulcan® Systems is uniquely positioned to aid those in the industry in the removal of mercury and mercury products from contaminated materials. Vulcan® has developed technology to remove mercury from substrates on a continuous basis. Our custom-designed and manufactured thermal equipment includes vapor recovery for the collection of vaporized mercury and has been demonstrated on both a pilot plant and a commercial basis. Our highly qualified staff is capable of designing systems to remove mercury from any industrial powders, such as activated carbon, fluorescent lamp powder, sludges and soil contaminated with mercury and mercury compounds.

Mercury can be captured from cement kiln dust (CKD), eliminating over 99 percent of mercury and helping U.S. cement plants to adhere to the 2015 National Emission Standard for Hazardous Air Pollutants (NESHAP) regulations. Capturing mercury also presents more opportunities for raw material use for cement producers. This process can also be applied to a variety of other materials, including coal ash, activated carbon, clay and other industrial dusts. Mercury capture results in an almost mercury-free raw material and an insoluble concentrated form of mercury, which can be safely cast into concrete, disposed of or recovered.

Mercury capture is an innovative method to reduce mercury emissions from cement kiln exhaust stacks and other emission sources. This technology can be utilized to capture both elemental and ionic forms of mercury. Mercury capture involves the use of thermal desorption to separate mercury from CKD, allowing the dust, essentially free of mercury, to be recycled and used anywhere within the process. This innovative process helps cement plants to meet the new NESHAP regulations, which will be in place in September 2015.

CUSTOM DESIGNED SOLUTIONS

For a smaller, portable solution, the Vulcan® Mobile Thermal Desorption Unit is a one ton per hour indirect thermal desorption system designed to remediate drill cuttings. This compact, mobile unit provides thorough remediation of drill cuttings contaminated with petroleum hydrocarbons. Optional components, including acid scrubbers and a flameless electric thermal oxidizer, may be added to the system for an additional cost.

Recovering drill cuttings and drilling muds is often practical and cost-effective environmentally sustainable process. Recycling and reusing drilling wastes can help operators meet disposal regulations, reduce disposal costs, limit truck traffic and save money on building well pads and roads. The proper disposal of such wastes prevents the contamination of water supplies and the soil. Thermal treatment of drill cuttings not only reduces their volume but also enables operators to recover reusable drilling fluids, resulting in significant cost savings while also augmenting environmental performance.

For more information on Vulcan® Systems, visit our website, vulcansystems.com, or contact Worldwide Recycling Equipment Sales, LLC at +1 (660) 263-7575 or marketing@getavulcan.com.

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