Frequently Asked Questions

eSteam™ has assembled a sample of some of the more frequently asked questions pertaining to the technology, production and operation of eSteam™.

"We're right in the middle of this nexus of unconventional heavy oil and oil sands recovery.

As the trend of the global oil industry shifts to the exploitation of more heavy crude oil, various technology companies will emerge to meet the industry challenges in this field and we believe eSteam™ is well positioned to overcome the obstacles inherent in heavy oil production.

eSteam™ believes that standing still is not a viable option, and that it's our responsibility to encourage a culture shift and acceptance of the new. Failure to do so will result in a significant loss of opportunity which none of us can afford." eSteam™ is a better mousetrap!

We encourage the reader to keep an open mind as you sift through this Q&As. They are questions asked of us and we are eager to respond and support our eSteam™ technology.

Question 1: "Surface steam generation of heavy oil has been around for about 55 years and the big boys have it down to a science. So what makes eSteam™ different?

It is not uncommon for those highly invested in a proven technology to be skeptical about eSteam™ and can be resistant to change. eSteam™ is truly cutting edge technology and no company in the heavy oil industry has successfully delivered downhole steam generation and below 2,500 ft. *To say that we have not met with some resistance from those invested in conventional surface steam injection would be a misstatement…and that's okay. If memory serves me right, the industry experienced the same reluctance when steam was first introduced into the oil fields in 1959.*

Therefore, we have provided herein an overview about our eSteam™ technology based on research and field-testing.

Delivering downhole steam results in a minimal loss of heat unlike conventional surface saturated steam. The downhole steam contains large amounts of sensible and latent heat that are derived from the superheat, which is not available with conventional saturated surface steam delivery systems. The steam then travels further and more quickly than conventional steam into the surrounding formation of the reservoir producing a larger steam radius than would occur using conventional steam methodology and comparable water. As it cools to a saturation state, a phase change occurs and the heat intensifies and is released deep inside the reservoir heating the surrounding formation, reducing oil viscosity, and vaporizing lighter hydrocarbons and moisture while increasing displacement energy and drawing off oil by increasing capillarity. (Note: There have been studies performed which present the hypothesis that increased heat increases capillary flow by decreasing cohesion relative to adhesion. A decrease in viscosity is also a result of increased heat due to increased kinetic energy which allow molecules to overcome attractive forces between them and the liquid flows more easily). This is similar to a "mini thermal cracking" wherein the large heavy hydrocarbon molecule is split into smaller, lighter components.

Effect on Reservoir Drive Mechanisms: The initial heat supplied during the first stage of heating with downhole steam can be expected to not only make the liquid fractions flow more easily, but will also vaporize the hydrocarbons when first mixing with the injected downhole steam and increase reservoir drive mechanisms. It can be expected that almost all of the potentially available fractions of the crude petroleum when coming into contact with the downhole steam will not only become less viscous, but will become a two-phase mixture of various hydrocarbon vapors and liquids of varying specific gravities and gaseous states. eSteam™ has the only EOR process where oil production is concurrent with steaming within the production wellbore. No extended steam soaking is required. Unlike Steam Flooding and Cyclic Steam Injection which require one week to 30 days of steam soaking, eSteam™ proprietary technology begins to see results within 72 hours.

Lateral Distribution: eSteam's™ downhole steam will travel further and faster with no condensation until it loses all degrees of heat. Conventional surface steam methods producing 500 – 600 deg. F steam, 80% quality, begin to lose heat and condense immediately in surface transmission and down hole. The eSteam™ downhole steam technology, which resembles a gas, is 100% quality steam in the wellbore and downhole; additionally, our steam does not require the significant pressure required by conventional steam methodologies to push surface steam into the reservoir. This becomes a real problem with conventional steam when the well is 2,500 or more feet deep because of the critical pressure of steam needed to reach that depth. Depending on the size of the down hole pipe, eSteam™ downhole steam is injected at pressures of 80 psig - 100 psig which will in no way affect the temperature of our steam. Therefore, based on the aforementioned steam quality and characteristics, lateral distribution between wells is achieved. Obviously, eSteam™ will lose heat as it travels and comes in contact with the surrounding formation, but continuous steaming at high temperatures will ensure the life of the steam in the reservoir from a radius and temperature standpoint. The steam will not begin to condense until it has lost all its degrees of heat, which means the heat will last longer and travel further. Based on the depth of the well more steam volume will be required.

Definitions of Sensible and Latent Heat: Sensible heat is the amount of energy released or absorbed by a chemical substance during a change of temperature. The term is used in opposition to latent heat, which is the amount of energy released or absorbed during a phase change, such as the condensation of water vapor. Latent heat is related to changes in phase between liquids, gases, and solids. Sensible heat is related to changes in temperature of a gas or object with no change in phase. Sensible heat causes change in temperature due to contact with colder or warmer air of surfaces. http://en.wikipedia.org/wiki/Sensible_heat

Question 2: What is superheated steam and how does it react in a heavy oil reservoir?

eSteam™ can achieve superheated steam in which the operating temperature of the gas (i.e., steam) exceeds that of the saturated steam temperature at the given operating pressure of interest. The superheated steam is physically produced by the addition of heat to saturated steam (being a mixture of both the liquid and gaseous phases of water) whereby the liquid phase has been removed in its entirety. Once the liquid phase has been eliminated, the addition of heat causes the temperature of the steam to increase beyond its associated saturation temperature. The resulting properties of the superheated steam then closely approximate those of a perfect gas as opposed to the mixed phase vapor associated with the saturated steam environment. In comparison with saturated steam whose temperature is bounded while the presence of liquid water exists, downhole superheated steam in the pure gaseous form can reach temperatures consistent with the degree of heating supplied by the respective source of heat. In addition, downhole superheated steam cannot condense (i.e., creating the presence of liquid water) without its temperature being reduced to the temperature of saturated steam at the pressure of interest. As long as the gas temperature is above that of saturated steam at the corresponding pressure, it is in the superheated regime and before condensation is possible, the number of degrees of superheat must vanish through some method or combination of methods of heat transfer (i.e., conduction, convection, and radiation).

So by virtue of the above definition, eSteam™ downhole steam, when compared to conventional surface steam at the same volume and pressure, will travel further into the formation at temperatures and velocities that far exceed conventional saturated steam. As it travels and comes in contact with the formation it will gradually lose its degrees of heat. Also, unlike conventional surface steam, because of the latent heat of vaporization carried by downhole steam, which is released upon reaching saturation temperature (a phase change), one could also assume that given the same volume and pressure, our downhole steam can deliver more heat deeper into the formation than conventional steam. A paper published by International Petroleum Technology Conference in March of 2013 measured the heating radius of conventional saturated steam versus that achieved by superheated steam in a heavy oil reservoir. The paper concludes that the superheated steam carries more heat than saturated steam, can take a relatively long time to cool during which time the steam is releasing very little energy, and transmits long distances which increases the heating scope or radius.

Question 3 "How does eSteam™ compare to routine hot-oil treatment for removing paraffin?"

Regarding the eSteam™ ability to de-paraffin a well using just downhole steam and no treatment fluids. This question refers to a "hot oil treatment". This is an accepted method in the industry to de-paraffin a well utilizing the circulation of heated fluid, typically oil, to dissolve or dislodge paraffin deposits from the production tubing. Such deposits tend to occur where a large variation in temperature exists across the producing system. A truck or skid-mounted unit is used to heat oil or treatment fluid. Hot oilers are routinely used in the removal of wax deposits from the upper wellbore section of wells in cold climates like Wyoming where low wellhead temperatures increase the susceptibility of heavy crude oil to wax precipitation. No treatment fluids are needed using eSteam™ it is evident that the ecological impact of eSteam™ can avoid using chemicals during this process.

Question 4 : "One more question about only partially saturating the formation and getting limited production. Are we saying in the gaseous state we get more penetration into more of the formation then current surface steam technology?

This is a good question, again, concerning lateral distribution of the steam within the reservoir. At the risk of being redundant, first, let's look at the properties of superheated steam: "Superheated steam is steam temperature of which exceeds that of saturated steam at the same pressure. It is produced by the addition of heat to saturated steam, which has been removed from contact with the water from which it was generated. The properties of downhole steam approximate those of a perfect gas rather than of a vapor. Saturated steam cannot be downhole when it is in contact with water...neither can superheated steam condense without first being reduced to the temperature of saturated steam. Just so long as its temperature is above that of saturated steam at a corresponding pressure downhole, and before condensation can take place"

So by virtue of the above definition, the eSteam™ downhole superheated steam, when compared to conventional surface saturated steam at the same volume and pressure, will travel further into the formation at temperatures and velocities that far exceed conventional saturated steam.

And this is why the eSteam™ technology is very different. It is our belief that because of the significant heat being introduced into the reservoir, steam volume is not an issue except as a delivery system to transfer the heat throughout the reservoir.

As you can see, volume and pressure are absolutely necessary for conventional steam methodology but may in fact is not as crucial for eSteam™, although it is anticipated that more volume will be needed for deeper wells and will have to be assessed reservoir to reservoir.

Question 5: "Can the eSteam™ technology remedy steam override or at least lessen it somewhat?"

We think that is a distinct possibility and here's why. First, let's look at the definition of steam override: When an oil reservoir is subjected to steam injection, steam tends to move up in the formation, and condensate and oil tends to move down due to the density difference between the fluids. Gradually, a steam override condition develops, in which the injected steam sweeps the upper portion of the oil zone, but leaves the lower portion untouched. Injected steam will tend to follow the path of least resistance from an injection well to a production well. Thus, areas of high permeability will receive more and more of the injected steam, which further raises the permeability of such areas. This phenomenon exists to an even larger degree with low injection rates and thick heavy oil formations. The steam override problem worsens at greater radial distances from the injection well because steam flux decreases with an increase in steam zone radius. (Oil Field Chemicals; Johannes Fink; August 2003)

No matter the actual depth of the well within reasonable parameters, when the steam (or any other pipe for that matter) is lowered through the casing, at the bottom terminal end in proximity to the reservoir surface, the major pressure that a downward flowing fluid must overcome is the frictional pipe losses that are proportionate to the square of the mass flow rate and inversely proportional to the inside pipe radius to the 5th power. Even if the down hole steam pipe is placed right at the top of the reservoir fluid surface, there are no other obstacles that the steam must overcome. The surface of the reservoir is what in mechanics is called a "free surface" and provides no magic backpressure to the flow of the downward directed fluid. The flow of the steam has effectively nothing to do with the bottom hole pressure, although the design of the casing pipe and cement must withstand many of the same lateral pressures. Nevertheless, the soil, rock, water, clay, etc. that the casing pipe is holding back must withstand an external pressure equal to a large fraction of an equivalent column of water equal to the depth of the well.

Now, what eSteam™ delivers is a high-quality steam in at the bottom of the wellbore at the reservoir face and this is great because the steam is a highly compressible fluid, unlike that column of water. The fluid must also have enough pressure at the top of the well head to allow the steam to be pushed (with a little help from gravity) to the bottom of the well and as long as water in the liquid state is injected into our extremely hot super heater tubing and the high-quality continues to be produced, and eventually the pressure of the steam at the top of the wellhead will reach a value that is in excess of whatever frictional losses are inherent with the chosen down hole inside pipe diameter and mass flow rate.

Furthermore, because we inject water at high pressures the steam will never back up into the water delivery system. These facts are consistent with the well known ideal gas law whereby the down hole steam pipe only resembles a closed system until the number of steam molecules increase the volume of gas contained within a "fixed" or "known" pipe volume, thereby increasing the steam pressure within the down hole steam piping.

eSteam™ is a "novel and disruptive" system that depends on rapid heating of liquid water flashing the very finely dispersed water droplets to steam that provides a steam delivery pressure that is primarily dependent on the backpressure exerted by the inside surface of the down hole steam piping almost to the point of being self regulating.

eSteam™ PRODUCTION

Question 1: " What does the production of an eSteam™ system consist of?"

The system is comprised of (6) primary off-the-shelf sub-systems.

Question 2: "How is eSteam™ fabricated and by whom?"

eSteam™ specifies and oversees the production assembly of the (6) subsystems. Quality assurance standards are applied to insure adherence to safety, regulatory requirements, and accreditations such as UL, ASME, NFPA, etc. Highly qualified supply chain partners produce the subsystems. Their experience, workmanship, accreditation, and capability, make them uniquely qualified to produce our subsystems. Their ISO quality standards and production discipline, insures performance and reliability of the subsystems. The respective supply partners do performance testing of the subsystems. Quality Assurance documentation travels with each subsystem. This insures the statistical probability of performance reliability at final assembly, and reduces final test time. Once assembled, the eSteam™ heater undergoes final testing before shipment to the end-user.

Question 3: How quickly can an eSteam™ system be produced?

Manufacturing time will be approximately 14 weeks and ½ week for testing and shipping.

eSteam™ OPERATIONS

Question 1: "What are the infrastructure requirements for eSteam™?"

a. Water must be supplied via an existing system, such as a municipal water supply or transported to site via truck and stored in external containers or treated produced water.

b. 480 three (3) phase electrical power must be available

c. Natural gas or propane must be available

Question 2: "How much maintenance is required?"

eSteam™ provides all maintenance. The operator is only responsible for costs associated with fitting the eSteam™ to a particular well.

Question 3: "Is the eSteam™ process dangerous?"

eSteam™ uses a low-pressure heater compared to conventional high-pressure steam boiler. Above ground bearing pipes are insulated and mechanically guarded to prevent accidents.

The eSteam™ process operates at comparatively low pressures. The system includes both mechanical and electronic pressure relief valves so that in the unlikely event of a backpressure occurrence, the machine stops.

All electrical connections are in compliance with local and UL code. The high-power components are inside a NEMA rated enclosure with a manual lock out.

Question 4: "What is the eSteam™ SOR (Steam to Oil Ratio)?"

The Steam-Oil Ratio (SOR) is a metric used to quantify the efficiency of oil recovery processes based on types of steam injection. It is a measure of the water and energy consumption related to oil production in cyclic steam stimulation and steam-assisted gravity drainage. Typical values are 3 to 8 for cyclic and 2 to 5 for SAGD. This means that 2 to 8 barrels of water converted into steam is used to produce one barrel of oil. The lower the SOR, the more efficiently the steam is utilized and the lower the costs. Therefore, SAGD is more efficient and would have lower related fuel and energy costs for the steam generation according to this analogy based on the above reported SORs. Because the eSteam™ revolutionary technology is defined as a means to deliver and transfer significant amounts of superheat to the reservoir without massive amounts of water and pressure, SOR will be lower compared to industry SORs because our technology is so novel.