

>> GROWTH UNDERPINNED BY OUR TECHNOLOGICAL CAPABILITIES

ENGINEERING HSE TECHNOLOGY HEIGHTENS PLANT SAFETY

Customers have become more interested in health, safety & environment (HSE) concerns in recent years, and HSE demands on engineering contractors at the design and construction stages are becoming stricter. In particular, safety evaluation regarding gas leaks/explosions is becoming even more important as a part of measures to reduce risks for plants at the design stage. JGC developed a gas explosion simulation system in order to respond to the safety demands of society and our customers, and for the purposes of efficient plant design with an appropriate level of investment.

This gas explosion simulation system comprises high-level total simulation technology using 3D computer-aided design (3D-CAD), computational fluid dynamics (CFD), and the finite element method (FEM).

The system carries out computer simulations based on various conditions such as:

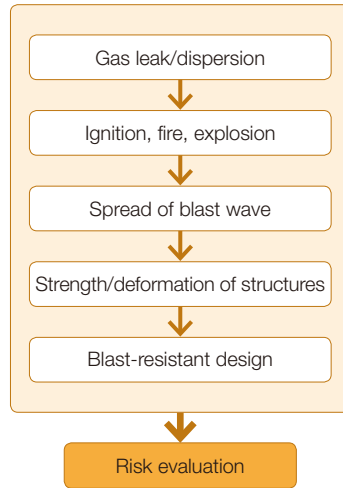
- Three-dimensional information including layouts for equipment, piping, and structures,
- Weather conditions such as wind direction, wind velocity, temperature, and atmospheric pressure,
- Gas conditions such as the type of gas leaked and volume of flow,

and predicts the behavior of gas leaks and their dispersion, fires, explosions, the spread of blast waves, and strength/deformation of structures. By designing blast resistance that reflects the simulation results and takes into account the impact on plant equipment and control rooms, and by conducting highly credible risk evaluation, we can secure the safety of the entire plant.

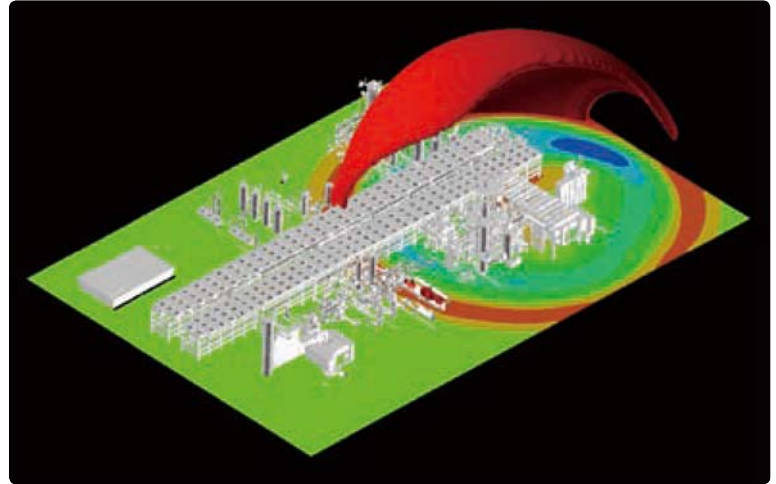
This sort of simulation technology can be used in a wide range of JGC's core businesses, such as gas processing plants, LNG plants, oil refining/petrochemical plants, as well as LPG Floating Production, Storage and Offloading (FPSO) plants.

By widely utilizing a high level of HSE technology, JGC will respond to customer needs, improve its competitiveness in winning orders, and raise the safety of its plants as it contributes to global environmental protection.

Procedure for gas explosion simulation



Blast wave after gas explosion (simulation result)



DEVELOPMENT OF HEAVY CRUDE OIL UPGRADING TECHNOLOGY USING SUPERCRITICAL WATER

As a result of brisk economic growth in Asia, global petroleum demand, mainly for light distilled oil, is forecast to increase about 1.3 times from current levels by 2030, while demand for heavy residual oil will decrease. Reflecting this situation, crude oil prices are soaring, and the price differential between heavy-grade oil and light-grade oil is expanding.

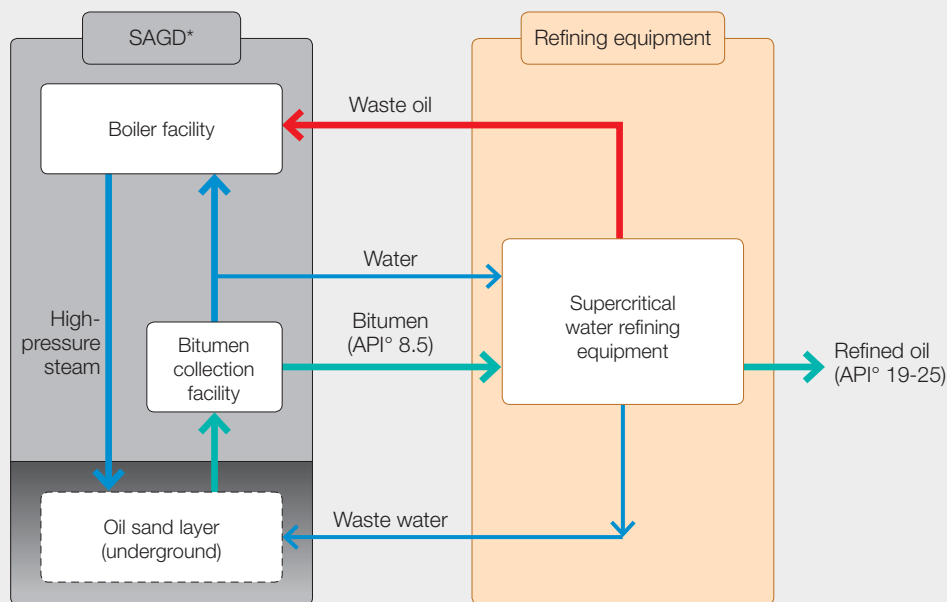
Meanwhile, utilization of heavy crude oil and extra-heavy crude oil has been increased and production volume is increasing steadily due to the practical limits on light crude oil production volume and from the perspective of improving energy security by diversifying supply sources. In particular, oil sands bitumen, a representative extra-heavy oil that represents reserves that are second only to those in Saudi Arabia, is attracting the world's attention. However, the viscosity and density of this type of oil are high and pipeline transport is impossible as is, so pipeline transport is made possible by diluting it with naphtha or refining it with upgrading facilities, such as the coking process and hydrotreating process at the well.

With the increase in extra-heavy crude oil production in recent years however, shortages in diluting agents and increased capital investments are becoming an issue restricting the growth of the use of this energy source. Therefore, there is a pressing need for upgrading technology that

can achieve easy and low-cost operation. JGC is currently developing heavy crude oil upgrading technology making use of supercritical water, jointly with Tohoku University, Chubu Electric Power Co., Ltd., Japan Petroleum Exploration Co., Ltd., and Nippon Oil Corporation in the form of a consignment research project from the Japan Oil, Gas and Metals National Corporation. The hydrothermal conversion of heavy crude oil proceeds with supercritical water. The technology is characterized by its relatively simple process configuration without catalysts and hydrogen. In the process, the heavy crude oil is allowed to convert to lighter oil with low viscosity that meets the specifications for transport by pipeline. The upgrading can be favorably achieved with reduced generation of coke and light gases which result from excessive cracking. When the process is used at a well using steam assisted gravity drainage (SAGD), water for SAGD can be shared in the process for the upgrading of bitumen by supercritical water. We conducted experiments to convert Canadian bitumen produced by SAGD with supercritical water and succeeded in producing upgraded crude oil that meets the requirements for pipeline transportation.

Going forward, JGC will conduct research and development by building on basic research done by Tohoku University, and aim at the commercialization of the upgrading of heavy crude oil with supercritical water as a technology originating in Japan, by cooperating with affiliated companies. We will be proceeding to an R&D program to collect engineering data for the scale-up and optimization of the process so as to raise cost competitiveness compared to processes such as coking, etc.

Example of combination of oil sand bitumen production and refining equipment using supercritical water



* SAGD: Steam Assisted Gravity Drainage