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Jet Fuel Pipelines And Storage Require Special Operation, Maintenance Considerations

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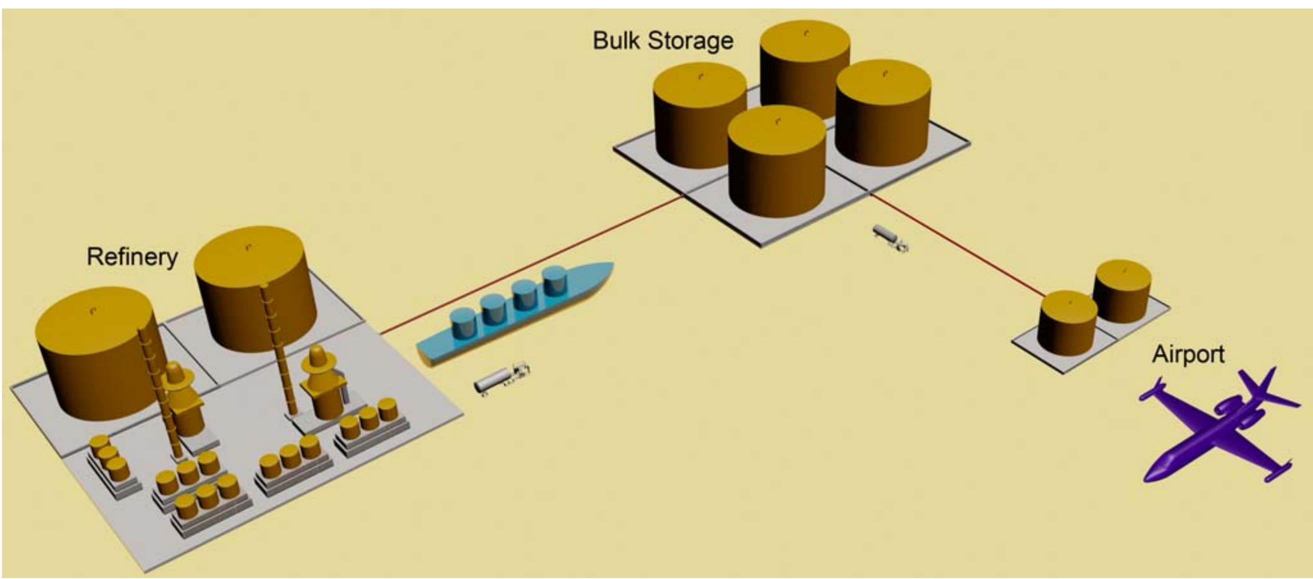

Jet fuel pipelines and bulk storage tanks require special operating and maintenance considerations. Jet fuels, specifically Jet A-1 and JP-8, are kerosene-type fuels used to power aircraft engines.

These fuels are subject to stringent quality requirements necessitating special equipment and engineering. Along the distribution chain, from the refinery to the airport, jet fuels are stored in bulk oil storage terminals and transported via pipelines, marine vessels and road tankers. It should be ensured that the fuel quality has not deteriorated to unacceptable levels along the distribution chain. Jet fuels have a flash point of 38oC and are combustible liquids. Measures to mitigate fire hazards should be in place for safe storage and handling.

Dedicated carbon steel pipelines are used to transport jet fuels to airport depots. In addition to their external coating and cathodic protection systems, the fuel pipelines have an internal coating applied to mitigate corrosion and fuel contamination. The pipelines should be piggable so that the capability for periodic cleaning and inspection is ensured. Pigs should be designed so as to not damage the internal coating.

Flow rate in pipelines is limited on the lower side by the self scouring velocity, typically 1.5 to 2 m/s and on the higher side by erosional velocity, typically 4 m/s or static electricity consideration which is 3 m/s.

Horizontal centrifugal pumps are used to provide the source pressure for pipeline transport. At terminals, jet fuels are passed through micronic filters to remove particulate matter and filter/separator systems to remove free water. If the pressure rating of the piping system and components is high, due to the need for high-source pressure for long-distance transportation, it is economical to use pressure-reducing valves at the downstream terminal and associated filtration units of a lower pressure rating.

At jointly operated facilities such as marine berths, where dedicated jet fuel piping is not available, jet fuels should be imported/exported via white oil lines reserved for middle distillates such as kerosene and gas oil. With multi-product pipelines, jet fuels are prone to higher contamination due to commingling of batches, surfactants which cling to the pipeline wall, free water and particulate matter. Leading and trailing grade interfaces must be diverted to slop tanks or non-aviation fuel storage tanks. Recertification is generally mandatory with multi-product pipeline transport. Batch planning and tracking is of particular importance to avoid jet fuels failing the quality tests.

Static Electricity

Jet fuel has a typical conductivity value ranging from 0.2-50 pS/m and is classified as a static accumulator. Military jet fuels and commercial Jet A-1 require the use of a static dissipator additive to increase the electrical conductivity of the fuel to a range of 50-300 pS/m, thereby turning the fuel into a static non-accumulator. However, the effectiveness of the additive diminishes with time and one cannot be sure if the conductivity is above 50 pS/m. Therefore, for long-distance pipelines and intermediate storage facilities, it is recommended that jet fuel be presumed to be a static accumulator.

If the fuel is a static accumulator it is recommended that its velocity in pipelines and long-distance piping be limited to 3 m/s to minimize charge generation. Short lengths of loading lines, such as marine loading arms, are sized with a velocity limit of 7 m/s.

Splash filling into tanks should be avoided and the tank inlet velocity limited to 1 m/s until the inlet nozzle is well submerged. This may be achieved by using properly sized tank inlet diffusers. After the initial filling period the flow rates may be increased as electrostatic charge generation due to mist formation and splashing against the tank bottom is suppressed.

The fuel comes into intimate contact with the surfaces of fine filter elements such as those in a micronic filter. Excessive charges are generated due to this process and therefore a residence time of 100 seconds is required before the fuel is discharged into the storage tank or compartment.

Storage Tanks

In this article, the term bulk storage tank refers to atmospheric, aboveground, vertical oil storage tanks. Free water and particulate matter, specifically rust, are the major contaminants arising out of bulk storage. Free water, in addition to what arrived by the transport system, can be accumulated in tanks by tank breathing and rain. A fixed cone roof tank is required to mitigate the ingress of water.

Water being denser than jet fuels, and very slightly soluble in jet fuels, will accumulate as a layer at the tank's bottom. The tank's bottom should be coned down, with a slope of about 1:30, toward a center sump. Water draw-off piping with a fast flush system should be provided from this sump. Free water at the tank bottom enhances bacterial growth and corrosion. To mitigate corrosion in the storage tank, a jet fuel-compatible, epoxy-coating system is applied to the whole of the tank's internal surfaces.

Tank outlet pipes, leading to pump suction, are provided with floating suction systems so that solids and free water at the tank's bottom are not transported.

Other Considerations

Cadmium, copper, galvanized steel, zinc or other active metals and their alloys which are effective catalysts for oxidation reactions have an impact on the fuel's thermal stability and therefore should not be used in storage, handling and distribution systems for jet fuel.

If jet fuels are contaminated by surfactants the effectiveness of filter/separator systems is impaired. Surfactants also prevent free water getting separated from water contaminated jet fuels in storage tanks by forming emulsions. Surfactants are generally removed by clay treaters at the refinery. However, there are scenarios wherein they can be picked up along the distribution chain. Use of clay treaters should be reviewed carefully as they also remove other additives such as the static dissipator.

Additive injection should be carefully reviewed based on specific requirements and location of injection. Generally, approved static dissipator additives and corrosion inhibitors are used for pipeline transport and at intermediate storage facilities. Other additives may include antioxidants, biocides, fuel system icing inhibitors (FSII) and leak detectors.

Author

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