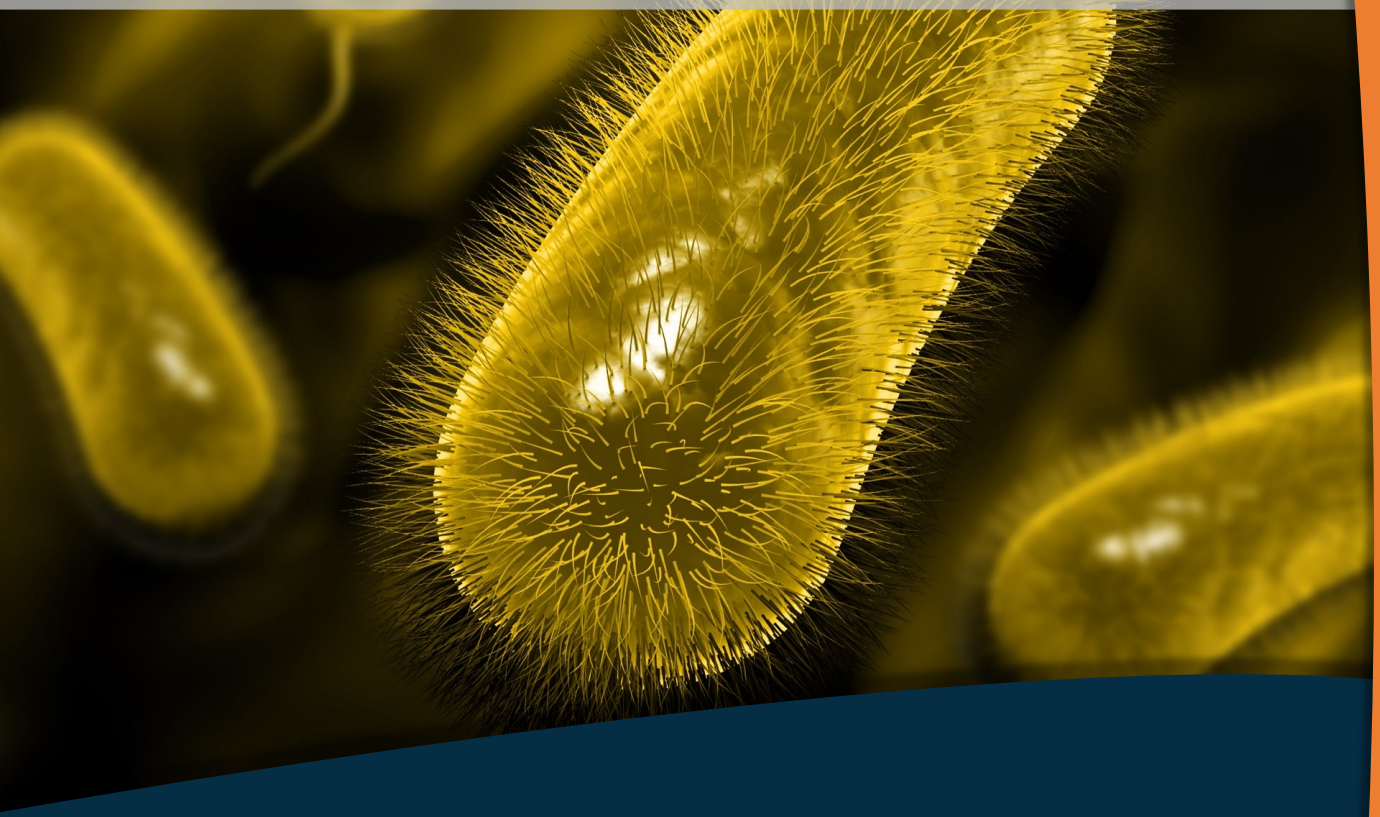
HYDRA FPB-77



Microbial Contamination Development & Consequences

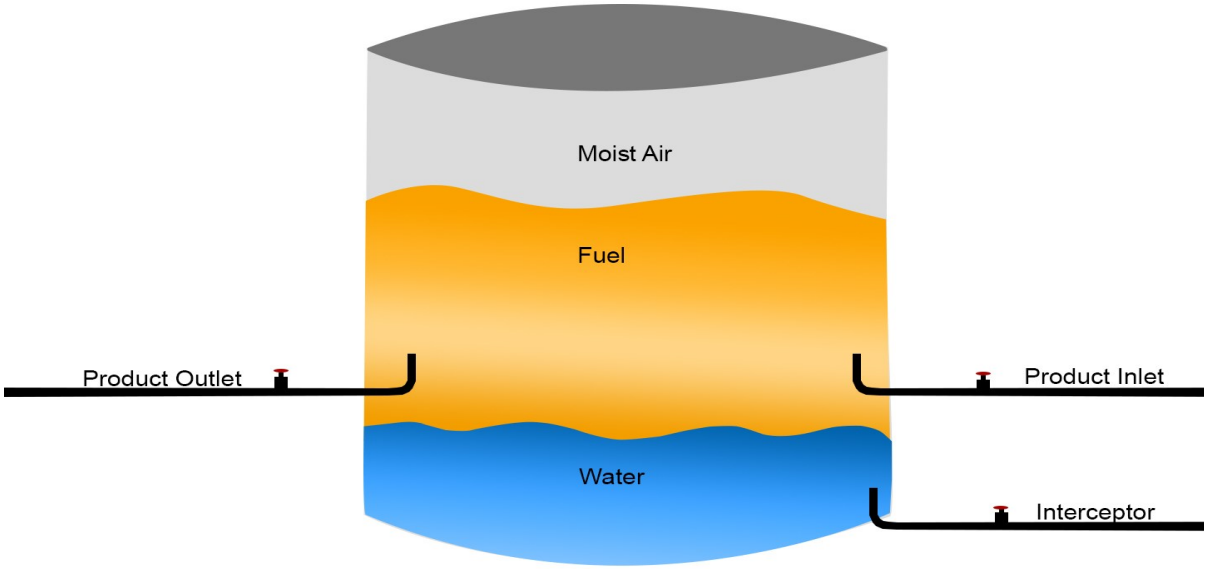
HOW MICROBIAL GROWTH DEVELOPS

Microbial contamination is very likely to occur whenever there is fuel and water present in a fuel storage system. Microbial contamination can occur to any type of fuels namely - gasoline, diesel, home heating, marine and aviation fuels. Furthermore, which single specific organism causes this spoilage or fuel degradation cannot be identified.

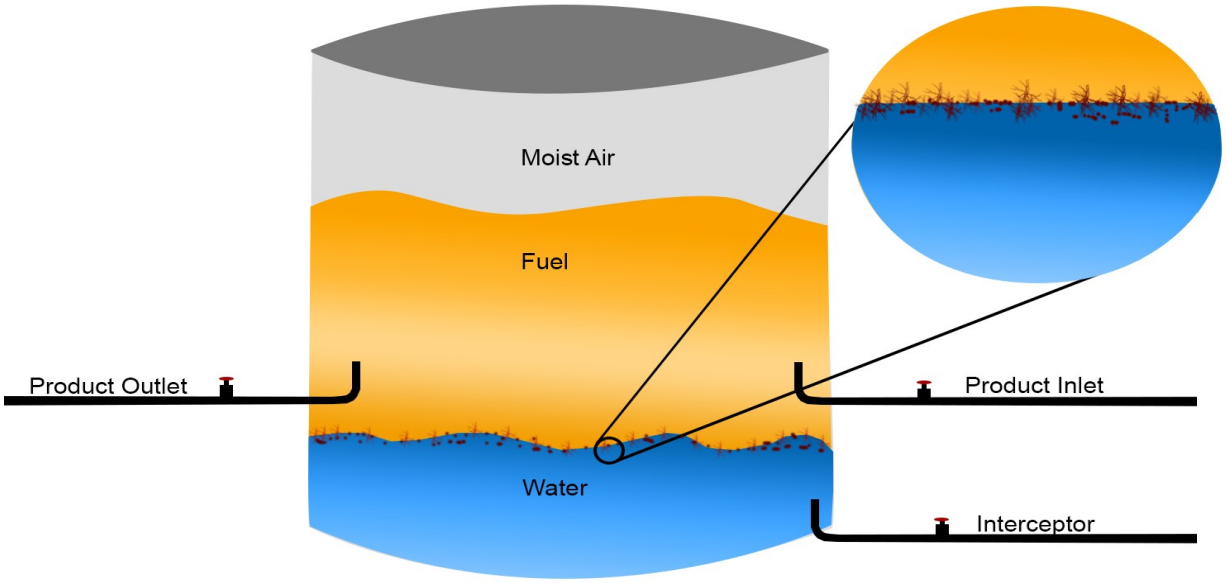
Even in a well maintained storage system, the water bottom is almost invariably present. This may result from a number of sources, some common examples are given below.

Some percentage of water is always present even in freshly refined fuel, this separates and settles down as fuel cools down. Water in the form of rain, snow can easily enter the fuel storage system through sampling ports, breather vents and ill-fitting seals present on floating roofs. The air present in the storage tank contains humidity which also condenses out and adds to the water present at the bottom.

Biofuel are hygroscopic. So, increasing the percentage of biofuel (now 7%) added to diesel also increases the chance of water bottom formation.

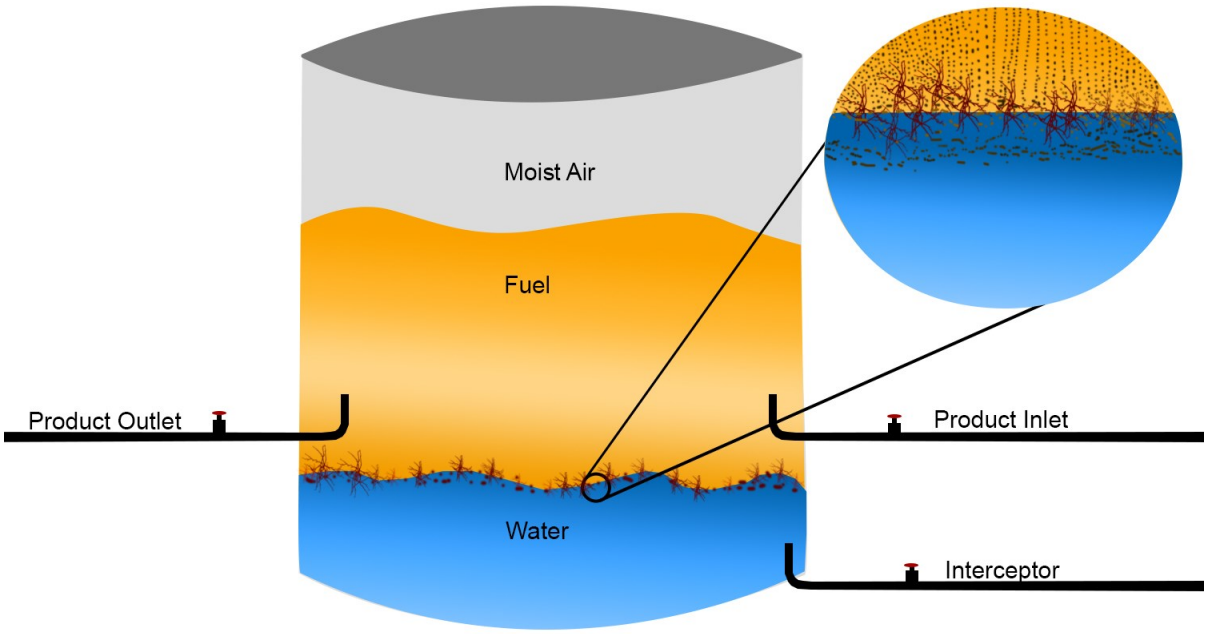


In addition water can accumulate also during transport of the fuel and while storing in tankers or barges. Moreover, certain end use applications - notably marine fuel are very susceptible to water entering the storage system.



MICROBIAL INNOCULATION STARTS

The water bottom is formed from the accumulation of water from all these sources. Microorganisms are present in both air and water. Microbial population begins to build up at the fuel-water interface. These microorganism survive in the water phase while feeding on the hydrocarbons present in the fuel. Thus this water-fuel interface provides a suitable breeding environment for the microorganisms. As a result, the population of the microorganisms explodes in a short period of time.



MASSIVE MICROBIOLOGICAL POPULATIONS,CORROSION PRODUCTS AND DETERIORATION OF FUEL QUALITY

Initially, only aerobic organism are predominantly present, they use the oxygen dissolved in water for respiration. But as the oxygen begins to deplete, more anaerobic organisms begin to thrive. These organisms are sulphate reducing bacteria which do not require oxygen for respiration. They produce hydrogen sulphide as a by-product which leads to corrosion of the storage system.

MICROBE SPECIES COMMONLY FOUND IN FUEL

Bacteria:

- *Clostridium sp.*
- *Desulfotomaculum sp.*
- *Desulfovibrio sp.*
- *Flavobacterium sp.*
- *Hydrogenomonas sp.*
- *Pseudomonas aeruginosa*
- *Pseudomonas sp.*
- *Sarcina sp.*

Fungi:

- *Aspergillus sp.*
- *Candida sp.*
- *Fusarium sp.*
- *Hormocoins resinae*
- *Yarrowia tropicalis*

Direct Effects of Microbial Metabolic Attack on Fuels

Fuel Haziness:

Haziness of the fuel is a clear cut indication that the fuel is out of specification. The increase in water content is the basic reason behind the fuel haziness which results due to the production of bio-surfactants. They are the by-products of microbial growth and they affects the surface tension at the fuel-water interface and thus, increases the solubility of water in the fuel.

Sulphate Reduction and Sulphide Production:

Sulphate reducing bacteria are anaerobic in nature i.e. they don't require oxygen for respiration. They are the oldest form of micro-organisms which can be traced back to 3.5 billion years ago. They actively participate in the sulphur cycle and converts sulphate to hydrogen sulphide. It produces odour similar to rotten egg. Hydrogen sulphide can evolve in storage tanks, bunkers and barges and leads to corrosion of the fuel storage systems.

Biomass Production and Biofilm Formation:

When water bottom is present in a storage system, in hot and humid environment, microbes tend to thrive. 100ppm (0.0001%) of water is sufficient for bacteria to grow in the fuel system. These microbial problems increases staggeringly when the microbes start to reproduce and form biofilms.

Indirect Effects of Microbial Contamination of Diesel Fuels

Sludge Formation:

Sludge are formed as a result of microbial debris which are deposited on the bottom of the storage tank. Sludge serves as a reservoir of microbial infection which will contaminate the fuel every time the tank is used. So, it should be removed as soon as possible. These sludge also provide a suitable environment for the microbes to cause tank corrosion.

Microbial Influenced Corrosion & Organic Acid Accumulation:

Sulphate reducing bacteria are anaerobic in nature i.e. they don't require oxygen for respiration. These bacteria reduces sulphate to hydrogen sulphide. Hydrogen sulphide is highly corrosive. When it enters the fuel system it causes severe pitting of the fuel tanks, the connecting pipes and engine wear.

Transfer-line Flow Restrictions:

Oxidation of fuel which takes place due to the presence of moisture in the fuel system leads to formation of inorganic particles. This inorganic particles causes stability problems and filter and pipes clogging.

Filter Plugging:

Biopolymers are formed as a result of microbial growth. Biopolymers along with other microbial debris stick to the filter and pipes causing severe blockage and reduce in flow rates. They can cause serious problems like engine failure or stalling at end user level.

Reduced Heat of Combustion:

The fuel quality degrades and the cetane number falls down rapidly when microbial contamination is established.

Degradation of Additives:

Additive rich in nitrogen and phosphorous can boost microbial growth. In the process degradation of fuel additives takes place and their effect reduces.

Odour:

Microbial contaminated fuel produces a foul odour due to the presence of sulphate reducing bacteria that produces hydrogen sulphide. Hydrogen sulphide has a rotten egg smell.

OTHER FACTORS INFLUENCING MICROBIAL CONTAMINATION

A wide range of fuel types are susceptible to microbial contamination where some of the fuels are more susceptible than the others. Recent study has shown that straight chain paraffin's gets easily contaminate and degrade soon while aromatic and olefins are found to be less susceptible.

Another factor that greatly influence microbial contamination is the duration and condition of storage. Poorly maintained fuel and fuel in storage for a long duration are likely to develop contamination

But the major cause of fuel contamination is the presence of water bottom in the storage tank. Unless this water is removed or treated with a proper biocide it is very likely that contamination will develop in the future.

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