

Proposal: Application of Centripetal Sedimentation Extraction Method to Crude Oil Storage, Stockpiling, and Marine Transport Facilities

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1. Purpose of the Proposal

Global crude oil stockpiles have increased, and mixtures of crude oils with different properties have made long-term storage and quality maintenance increasingly difficult. Existing storage tanks and stockpiling facilities are operated primarily for “storage only.” This proposal introduces a method that enables *centripetal sedimentation and separation* within such tanks, allowing crude oil to be *lightened and partially refined during storage*. The concept aims to add a separation function to existing infrastructure without major structural changes.

2. Overview of the Centripetal Sedimentation Extraction

Method: PETACLONS-EX

The PETACLONS-EX method forms thin-layer centripetal vortex flows inside a tank. Fluid is drawn from the tank bottom center through a filter (Japanese Patent No. 4495918) and discharged tangentially from the lower sidewall, generating a forced vortex. This forced vortex propagates upward and produces an unlimited number of thin free-vortex layers throughout the tank.

These thin-layer vortex flows naturally separate heavier components downward and lighter components upward. According to Japanese Patent No. 6666176, heavier fractions are transferred to the next tank, while lighter fractions are returned to the original tank, enabling unlimited cyclic separation. Multiple tanks can be connected in series to match the number of desired separation categories.

A head pressure can be applied to the return circuit, allowing RO and UF membrane filtration to be incorporated. This enables multi-stage enrichment of light water (H₂O), increasing natural water purity from 99.985% (3N) to 99.99% (4N), producing a new category of “light-water-rich” product.

When the tank system is sealed, operational safety is improved, and light hydrocarbon gases (natural gas components) originating from crude oil can be collected in the upper gas space. The sealed environment also allows controlled management of atmospheric gas species. Unlike conventional water-washing, settling, or extraction operations, repeated passage through numerous thin-layer interfaces greatly increases separation efficiency and reduces the number of tanks required.

3. Applicability to Storage Tanks, Stockpiling Facilities, and Crude Oil Tankers

When applied to crude oil storage tanks or stockpiling facilities at production sites, the method enables crude oil to lighten during storage, while heavier fractions, water-soluble components, and metal ions naturally migrate to downstream tanks. As a result, storage itself functions as part of a refining process, increasing the value of stored crude oil.

In peacetime operation, tanks filled with freshwater can produce light-water-rich water as a new product. This water can also be supplied as ballast water for crude oil tankers returning to producing regions. Conversely, injecting crude oil into freshwater tankers allows centripetal sedimentation to proceed during marine transport, enabling simultaneous transportation and lightening of crude oil.

4. Consideration of Stakeholder Interests and JOGMEC' s Position

Improving crude oil quality and increasing its value may affect producing countries, transport operators, and refining companies. Coordination among stakeholders will be necessary. Importantly, the **Oil-SP value% (oil-phase solubility parameter)** serves as a practical indicator of crude oil quality, and PETACLONS-EX utilizes differences in Oil-SP values to extract water-soluble and heavy components in a staged manner. This proposal is presented as a technology that *supplements* existing storage functions and aligns with JOGMEC' s mission of ensuring stable resource supply and enhancing national stockpiling capabilities.

5. Conclusion

The PETACLONS-EX method adds centripetal sedimentation and separation functions to existing crude oil storage, stockpiling, and transport facilities. It enables crude oil to lighten, partially refine, and release light hydrocarbon gases during storage. As global stockpiles grow and crude oil properties diversify, this approach offers a low-cost improvement strategy utilizing existing infrastructure. Technical evaluation would be greatly appreciated.

Research on heavy-water/light-water separation has been submitted to Tokyo Electric Power Company and Mitsubishi Research Institute and is published on the website: <http://www.fineclay.co.jp/>

Public discussion meetings on civic technical issues are held at Osaka Metropolitan University Cultural Exchange Center, Osaka Station 2nd Building, 6th Floor.