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SYNGUARD

PLEATED LOFTED MEDIA PACKS FOR MANAGING FOULANT PRECURSORS IN REFINING AND RENEWABLE PROCESSING

Technical Bulletin

JONELL SYSTEMS™
Filtration Group®

Filtration challenges in modern refining increasingly reflect changes in feedstock variability and contaminant morphology. Within conventional fossil-derived refining, heavier fractions, opportunity crudes, and cracked intermediates introduce contaminant systems that behave differently from the rigid particulate solids traditionally assumed in filtration design. Comparable behaviors are also encountered in renewable processing environments, where variability in feed composition can influence the structure and stability of contaminants entering the process.

Operational problems in these systems often arise from interactions between suspended solids and reactive hydrocarbon components present in the stream. Particles such as corrosion products or catalyst fines can act as nucleation sites for hydrocarbon deposition. Depending on feed composition and processing history, the associated organic material may include oxidatively generated gums, polymerization products derived from unstable cracked fractions, paraffinic associations, or heavier fractions such as asphaltenes.

These interactions can produce hybrid organic–inorganic agglomerates that behave as viscoelastic structures rather than rigid particles. Such structures often represent early stages in fouling pathways, gradually evolving into cohesive deposits capable of fouling heat exchangers, guard beds, and catalytic reactors.

Managing these systems therefore requires addressing contaminant populations before deposit formation occurs. Intercepting foulant precursors and early-stage agglomerates within the filtration system can reduce their propagation through the process.

The Synguard filtration platform was developed to address these contaminant systems through engineered pleated lofted media packs designed to stabilize and retain these precursor structures within the filtration medium.

Contaminant Agglomeration and Filtration Behavior

Contaminant systems encountered in refining and renewable processing environments rarely consist of rigid particles alone. Suspended solids frequently interact with reactive hydrocarbon components present in the fluid phase, producing hybrid organic–inorganic agglomerates in which particulate matter acts as nucleation sites for hydrocarbon deposition.

Depending on feed composition and processing history, the associated organic material may include oxidatively generated gums, polymerization products from unstable cracked fractions, paraffinic aggregates, or heavier hydrocarbon fractions such as asphaltenes. As these materials accumulate on suspended solids, clusters may develop consisting of inorganic cores surrounded by hydrocarbon-rich organic matrices.

The morphology and stability of these agglomerates are sensitive to operating conditions, particularly temperature. Changes in the operating window influence hydrocarbon solubility and association behavior, altering whether these species remain dispersed in the fluid phase or associate with suspended particles. Paraffinic components may participate in aggregation mechanisms even when operating above classical wax appearance thresholds when interactions with suspended solids promote association.

Figure 1: Fouling in Heavy Hydroprocessing Speeds

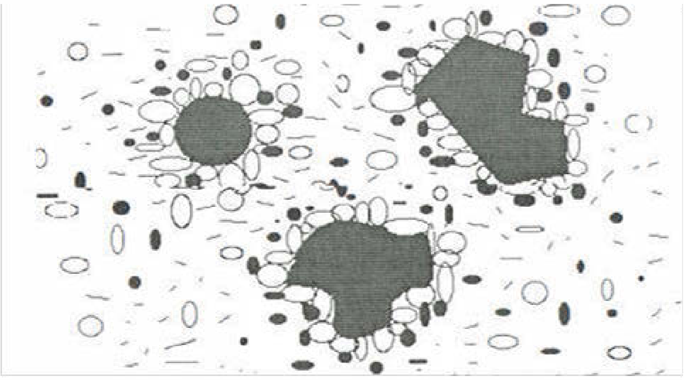


Figure 1: Adapted schematic showing co-existing organic phases and agglomeration morphologies, illustrating the heterogeneous nature of heavy hydrocarbon deposition systems.

When subjected to conventional surface filtration, the deformable nature of these agglomerates can significantly influence filtration performance. Hydrocarbon-rich components may deform under hydraulic forces and redistribute within the filtration cake, occupying pore spaces between particles and progressively reducing permeability. This behavior is commonly described as compressible cake formation, where increasing differential pressure leads to further compaction of the cake structure.

Operationally, such systems often exhibit rapid differential pressure increases in surface filtration equipment and shortened filtration cycles in automated metallic filtration systems as dense cakes form at the filtration interface.

Surface-Energy-Engineered Pleated Lofted Media Packs

The Synguard platform addresses these contaminant systems through engineered pleated lofted media packs designed to intercept and stabilize foulant precursors before they evolve into larger deposits.

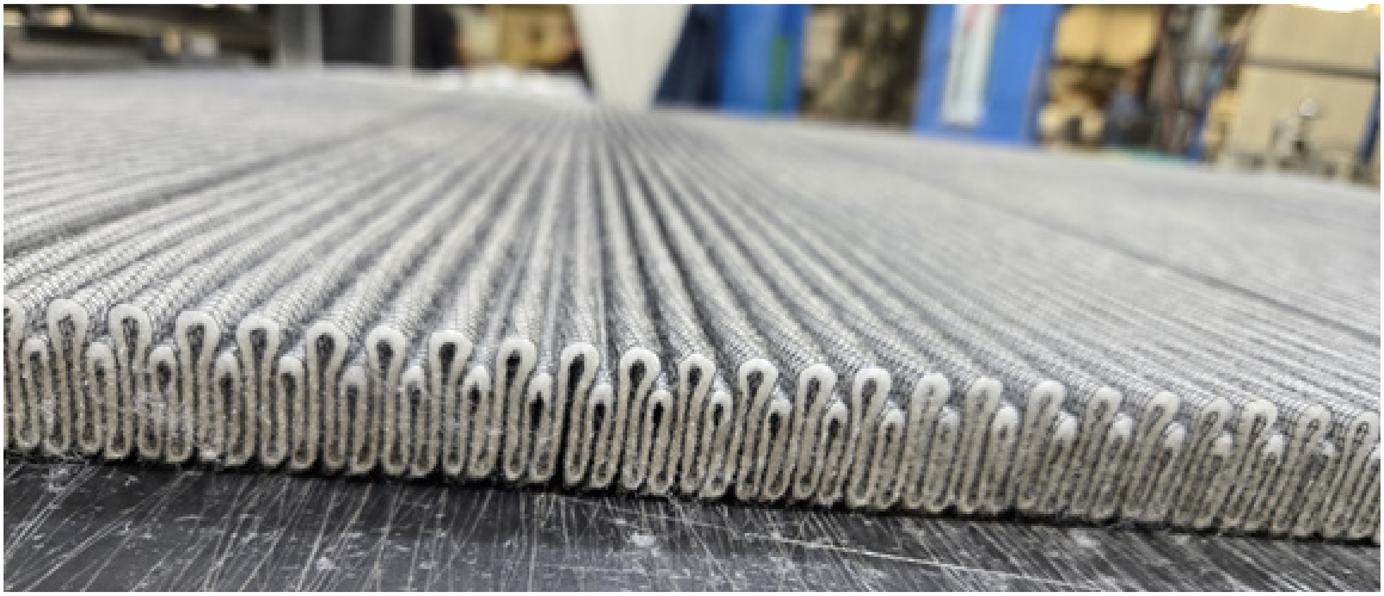


Figure 2. Engineered media pleat pack ready for assembly into a large format cartridge

Pleated geometries increase filtration surface area and reduce superficial velocity through the filtration medium, limiting localized flow impingement and shear forces acting on deformable agglomerates.

Within the filtration element, lofted fiber matrices create a three-dimensional network capable of accommodating particles and agglomerates throughout the depth of the media pack. Fiber intersections form interstitial regions where contaminant clusters can become immobilized within the filtration structure.

Rather than concentrating contaminant loading at a single filtration interface, Synguard media distribute contaminant capture throughout the depth of the media pack. This architecture reduces the formation of dense compressible cakes while maintaining permeability during extended operation.

A defining element of the Synguard concept is the use of fiber surface energy as a design parameter in media pack engineering. Conventional filtration media are typically selected based on pore structure and chemical compatibility. In systems containing deformable hydrocarbon-derived contaminants, however, interactions between the contaminant phase and the fiber surface can significantly influence capture behavior.

By controlling fiber surface energy, Synguard media packs can be engineered to influence how hydrocarbon-derived materials interact with the filtration structure. In some configurations, lower surface energy fibers promote stabilization of contaminant agglomerates within the interstitial lofted structure of the media. In others, higher surface energy fibers promote interactions between hydrocarbon species and the fiber surface.

Two lofted synthetic media configurations were developed to evaluate these mechanisms. These configurations, designated Synguard MT and Synguard HT, incorporate fibers with different surface interaction characteristics.

DESCRIPTION	
Description	**Best suited for**
Low surface energy (paraffinic engineered thermoplastic); reduces adhesion of waxy or neutral gels while enabling stable retention of fine particulates without blinding.	Feeds dominated by paraffinic or saturated species, where deformables have limited polarity. Lower-energy surfaces help limit film formation while allowing volumetric retention of softened wax/resin clusters.
High surface energy (aromatic engineered thermoplastic); promotes finer particulate and semi-gel retention.	Feeds containing oxidized gums, oxygenated resins, asphaltene-leaning semi-gels, and iron-bearing fines. Earlier anchoring within the depth matrix reduces downstream loading.

Figure 3: Retention mechanisms based on surface energy

Figure 3a. Low surface-energy matrix showing contaminants retained within interstitial fiber spaces. The reduced adhesion prevents film formation, allowing semi-deformable material to lodge mechanically between fibers, maintaining open flow paths and long service life.

Figure 3b. High surface-energy matrix exhibiting multiple contact points where asphaltenic micelles and semi-gels adhere to the fiber surface. The stronger intermolecular attraction promotes adsorption and depth immobilization of fine carbonaceous clusters for enhanced contaminant capture.

By combining lofted fiber architectures with controlled surface interaction characteristics, Synguard media packs promote progressive depth population of foulant precursors rather than rapid accumulation at a single filtration interface.

Microstructural examination of populated elements confirms that contaminant agglomerates become distributed within the lofted fiber matrix. Micrographs of used media show progressive depth loading within the fiber structure rather than surface blinding typical of surface filtration systems.

Field Evaluation of Synguard Media Packs

Field evaluations were conducted in two processing environments to assess the performance of Synguard pleated lofted media packs under contaminant conditions representative of both renewable processing and hydroprocessing of heavier fossil-derived feeds.

In both installations, the Synguard elements operated with **approximately 30–40% of the effective filtration surface area of the conventional surface filtration elements** previously used in the service. Despite this significantly lower installed surface area, the systems maintained **equivalent effluent cleanliness and downstream process performance.** In both cases, the Synguard elements demonstrated substantially **extended life in service**, consistent with depth population of the lofted media structure rather than rapid surface blinding. The resulting improvement in element service life translated directly into reduced maintenance frequency and measurable operating cost reductions, including **annualized savings approaching $1 million in one installation**.

The following sections summarize the operating behavior observed in the two services.

Field Case Study: Renewable Processing

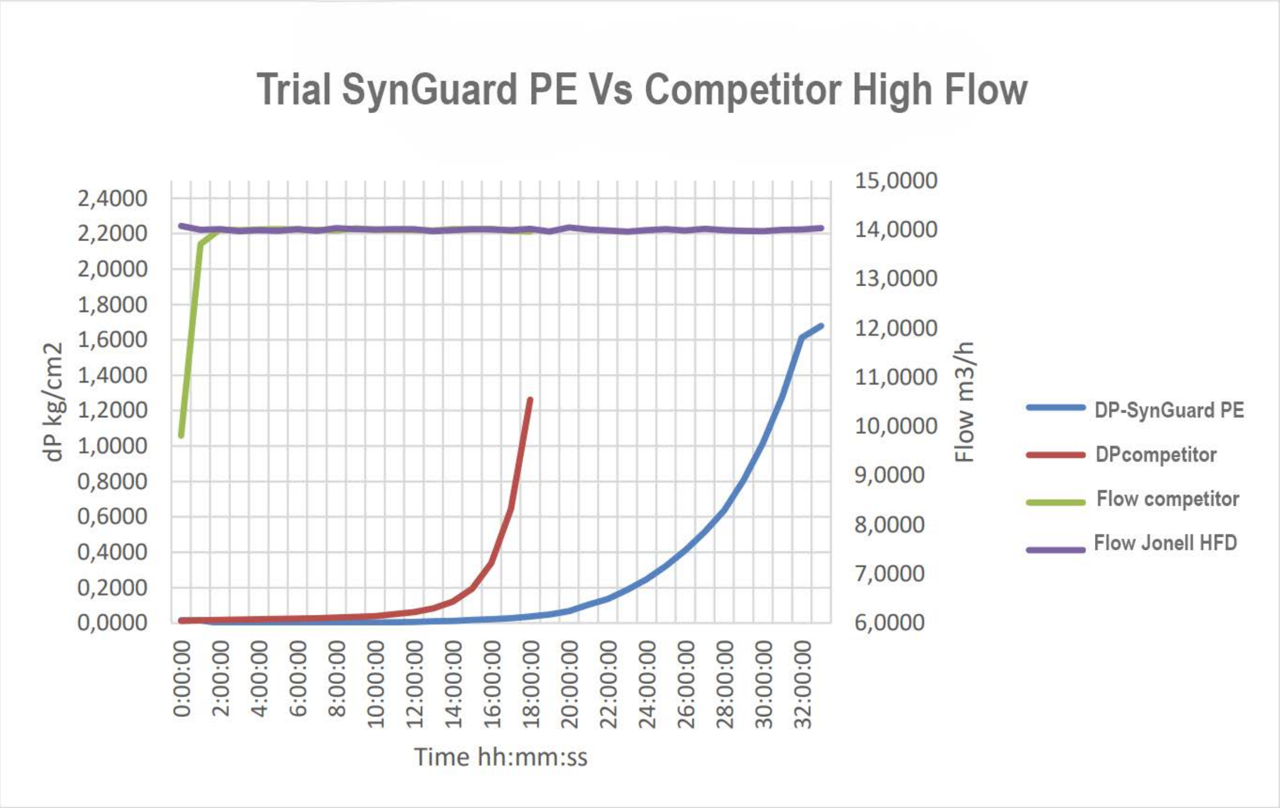
A Synguard polyester-based lofted media pack was evaluated in renewable processing service to improve interception of foulant precursors within the filtration system.

During operation, differential pressure increased gradually over time, indicating progressive population of contaminants within the depth of the Synguard media structure rather than rapid surface blinding typical of conventional surface filtration.

Microscopic examination of populated media revealed hybrid agglomerates composed of inorganic particles associated with hydrocarbon-derived organic material retained within the lofted fiber network. This loading pattern confirmed that contaminant capture occurred throughout the media depth rather than at a single filtration interface.

Representative pressure behavior is shown in Figure 4.

Figure 4: Trial SynGuard PE Vs competitor High Flow



Field Case Study: Hydroprocessing of Heavy Feeds

A filtration system incorporating Synguard engineered lofted media packs was installed upstream of a hydroprocessing unit processing variable heavy feeds.

During operation, differential pressure increased gradually and remained stable relative to the rapid pressure rise typically observed with conventional surface filtration in similar services. The pressure behavior indicated progressive depth population of foulant precursors within the lofted fiber structure.

Analysis of populated media confirmed the presence of organic–inorganic agglomerates retained within the fiber network. Field samples collected upstream of the unit showed hydrocarbon-rich material associated with inorganic particles, consistent with the foulant precursor mechanisms described earlier.

Representative pressure behavior is shown in Figure 5.

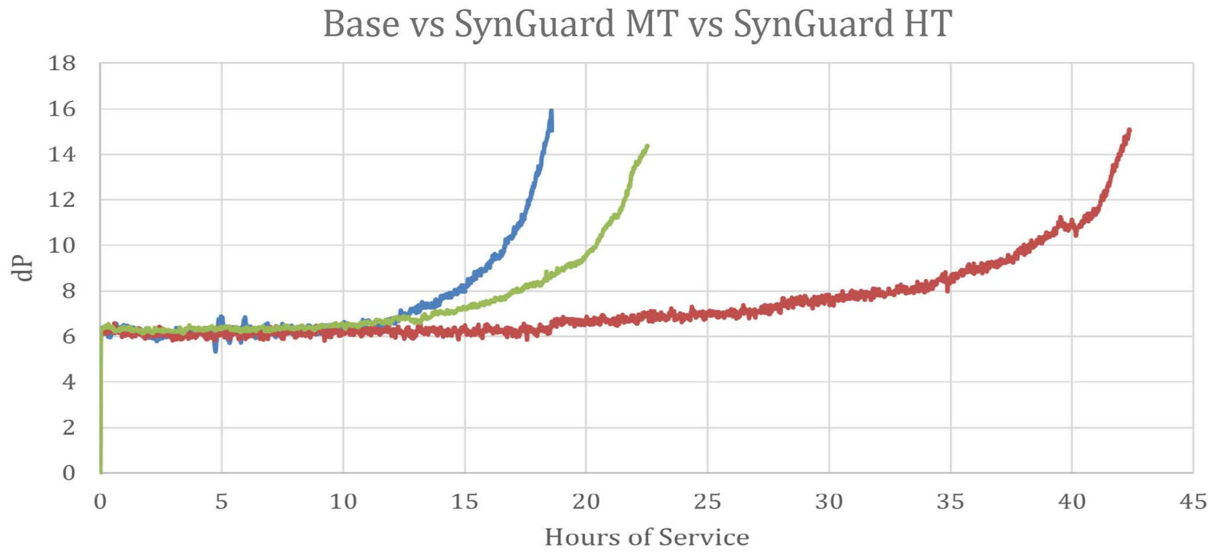


Figure 5: Comparative differential pressure performance of lofted pleated media (green and brown) versus conventional surface-pleated media (dark blue) in a HVGO/HKGO/ARDS feed containing semi-deformable contaminants. The lofted matrix maintains low, stable ΔP throughout extended service by adsorbing deformable clusters within the depth structure, while the surface filter exhibits rapid blinding and premature pressure rise due to gel accumulation and limited pleat utilization.

Integration with Metallic Filtration Systems

Synguard filtration elements may be deployed either as standalone filtration systems or as conditioning stages upstream of other filtration technologies.

When installed upstream of automated metallic filtration equipment, Synguard media packs can stabilize viscoelastic agglomerates and reduce the formation of dense compressible cakes on downstream filtration surfaces. By moderating cake density and reducing the fraction of foulant precursors reaching downstream filtration stages, this configuration may extend filtration cycles and improve operational stability.

Conclusions

Contaminant systems encountered in modern refining and renewable processing environments increasingly involve interactions between suspended solids and reactive hydrocarbon species that can form deformable organic–inorganic agglomerates. These structures behave differently from rigid particulate contaminants and can contribute to progressive fouling in downstream equipment.

The Synguard filtration platform addresses these systems through pleated lofted media packs engineered to stabilize and retain foulant precursors within the depth of the filtration structure. By combining controlled fiber surface interaction characteristics with a three-dimensional lofted media architecture, Synguard elements promote progressive depth population of contaminants rather than the rapid formation of dense surface cakes typical of conventional surface filtration.

These observations highlight the importance of considering contaminant morphology and behavior in filtration design. Engineering media packs to intercept and stabilize foulant precursors provides a practical approach for conditioning contaminant systems before deposit formation occurs, improving filtration stability and supporting reliable operation across a range of refining and renewable processing applications.

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