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Micronised High-Density Polyethylene (HDPE) as Functional Filtration Media

1. Executive Summary

Micronised High-Density Polyethylene (HDPE) is a polymer-based filtration medium engineered for use as a sacrificial, contamination-free filter aid and polishing media in industrial liquid processing systems. Unlike conventional mineral filter aids, micronised HDPE offers zero inorganic residue, chemical inertness, and mechanical stability, making it suitable for applications that demand controlled pressure drop behavior, open cake structure, and extended filtration cycles.

2. Introduction

Filtration of non-aqueous liquids in high-purity applications requires media that support effective cake formation, enable stable permeability under operating pressures, and avoid the introduction of inorganic contaminants. While mineral filter aids have been historically used for such applications, their inorganic nature can introduce ash, trace metal ions, or silica residues — which are undesirable in contamination-sensitive environments.

Micronised HDPE is designed to fulfil the role of a polymer-based filter medium, specifically engineered to deliver predictable performance across a range of filtration hardware, including pressure-leaf filters, precoat systems, and body-feed polishing stages.

3. What Makes Micronised HDPE Different

High-Density Polyethylene (HDPE) is a polyolefin with higher crystallinity and stiffness compared to low-density variants. When micronised into a controlled particle-size powder, HDPE forms a filter cake with a relatively stiff and open structure. This structural characteristic results from the inherent physical properties of the base polymer and influences how the cake behaves under differential pressure (ΔP) during filtration.

Key differentiators of micronised HDPE include:

- **Stiff cake formation:** HDPE particles deform less under pressure compared to softer polymers, maintaining mechanical stability and permeability.
- **Controlled permeability:** The open structure resists cake densification, sustaining flow rates over extended cycles.
- **Non-contaminating:** As a polymer, HDPE leaves no mineral ash or ionic residues, preserving liquid purity.
- **Process compatibility:** Chemically inert in many organic systems, making it suitable for a wide range of liquid processing environments.

4. Functional Filtration Mechanism

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Filtration performance is governed by how particles assemble into a coherent cake on the filter medium under pressure. Micronised HDPE, due to its high stiffness, resists particle collapse and structural compaction. This leads to:

- **Stable pressure-drop progression:** Less rapid increase in ΔP compared to softer particles, which is critical in longer or high-throughput filtration cycles.
- **Sustained permeability:** An open cake architecture allows consistent flow even as solids accumulate.
- **Predictable cake behavior:** Less sensitivity to variations in operating conditions, leading to reproducible filtration performance.

This contrasts with softer polymers, which may deliver excellent initial sealing or conformity but may compress more rapidly under load, reducing permeability and increasing pressure drop.

5. Typical Applications

Micronised HDPE resin as filtration media is used across several industrial liquid systems, including:

- **High-purity oils and fluids:** Such as PAO lubricants and transformer oils where extended cycle filtration with low ΔP rise is desired.
- **Plasticiser and ester applications:** Where removal of fine particulate contamination without residual ash is required.
- **Polishing filtration:** In chemical manufacturing where final polish steps demand mechanically stable, non-contaminating media.
- **Continuous or high throughput systems:** Where cake stability over extended runs improves operational reliability.

6. Positioning vs Mineral Filter Aids

Conventional mineral filter aids — such as diatomaceous earth, perlite, or silica — are inherently inorganic and can introduce trace residues into the filtration system. These residues, while often acceptable in commodity applications, are unsuitable for high-purity liquid systems where contamination control is critical.

Micronised HDPE is a polymeric alternative that:

- leaves **no inorganic ash**,
- is **chemically inert** toward many non-aqueous liquids,
- supports stable cake integrity without dense compression,
- and reduces the potential for trace contamination.

This makes micronised HDPE a preferred filtration medium in applications where purity and mechanical performance are both critical.

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7. Micronised HDPE in the Polymer-Based Functional Filtration Media Group

Within the Polymer-Based Functional Filtration Media product group, micronised HDPE is positioned alongside other polymeric media such as micronised PP and LDPE. The differentiated performance of HDPE supports applications that prioritise pressure drop stability and extended cycle performance — complementing the balanced performance of PP and the conformable sealing of LDPE.

By offering a spectrum of polymer mechanics, end users can match filtration media to specific process requirements rather than defaulting to a one-size-fits-all solution.

TABLE OF COMPARISON OF DIFFERENT FILTRATION MEDIA AND THEIR BENEFITS

Application / Liquid System	LDPE	PP	HDPE	Recommended Rationale
DINP / DIDP / DOTP (electronic or specialty grade)	◯	✓	✓	PP for balanced filtration. HDPE preferred for long cycles and pressure stability in high-throughput DINP polishing
PAO Oils (high-purity lubricants)	◯	✓	✓✓	HDPE maintains open cake structure and stable flow in low-viscosity PAO systems
White Oils (pharma / cosmetic grade)	✓	✓✓	◯	PP as reference; LDPE useful for fine polishing stages and sensitive filtration surfaces
Epoxy Resin Solutions	✓✓	✓	◯	LDPE improves cake conformity in higher-viscosity epoxy systems where sealing and surface coverage are critical
Polyurethane Prepolymers	✓✓	✓	◯	LDPE supports compliant cake formation and reduces bypass in viscous liquids
Transformer Oils / Electrical Fluids	◯	✓	✓✓	HDPE preferred for long cycle life and stable ΔP behavior

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Specialty Ester Intermediates	◯	✓✓	✓	PP as primary choice; HDPE used when higher pressure stability is required