DAVID BROMLEY ENGINEERING LTD.
"2010-celebrating 30 years of business"
davidbromley@dbe2000.com
604 9220137 telephone
www.dbe2000.com

Summary of Nanoflotation Water Treatment Technology

纳米浮选水处理技术概要

There are Two Steps in Nanoflotation

纳米浮选技术包括两个部分：

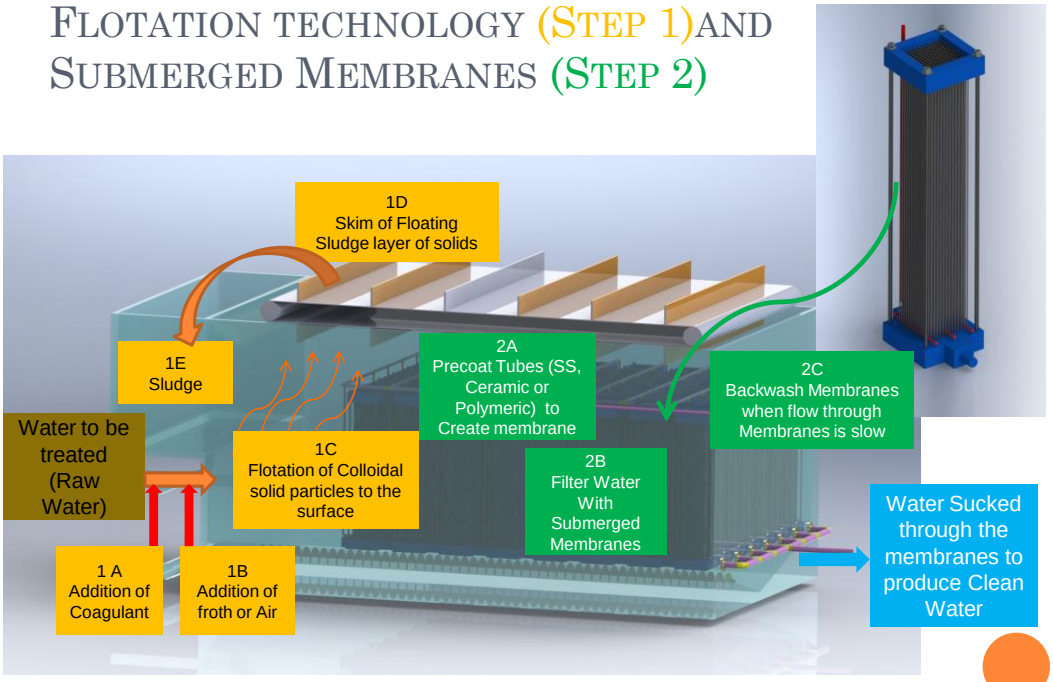
Step 1: **Flotation** followed by

步骤 1：浮选技术

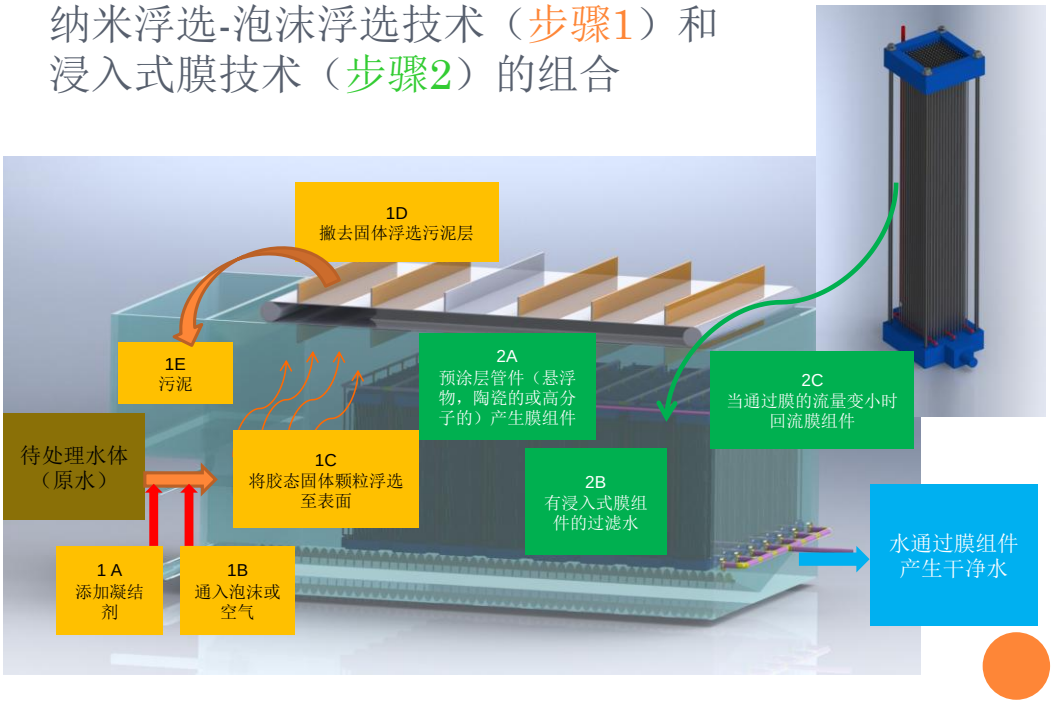
Step 2 : **Filtration** using a unique membrane filtration concept where the membrane skin layer is constantly being replaced using a precoat technology. The precoat technology encourages colloidal solids to attach to the membrane skin layer and foul the layer . Once the precoat is exhausted it is then replaced with a new precoat layer.

步骤 2：纳米浮选技术应用了一个独特的膜过滤概念：采用预涂层技术使膜外层不断被替换，预涂层技术使胶态固体依附在膜外层并使其污染，一旦预涂层被用尽，将替换一个新的预涂层。

NANOFLOTATION- COMBINATION OF FLOTATION TECHNOLOGY (STEP 1)AND SUBMERGED MEMBRANES (STEP 2)



纳米浮选-泡沫浮选技术（步骤1）和浸入式膜技术（步骤2）的组合

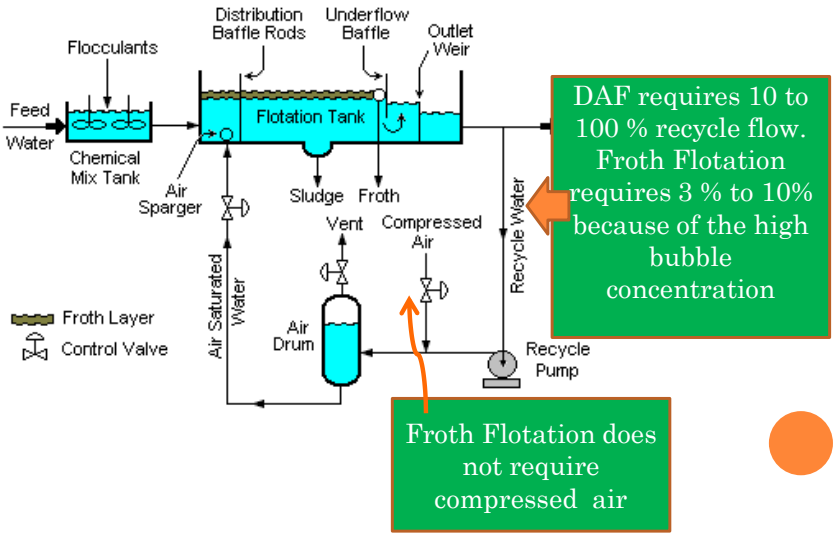


Step 1: Froth Flotation or Dissolved Air Flotation (DAF)

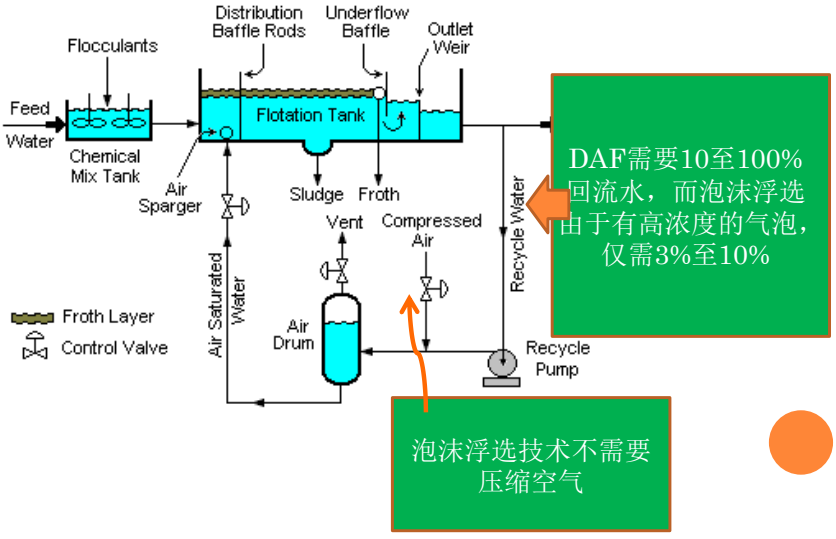
步骤 1：泡沫浮选或溶气浮选法

1. The ionic charge (positive+ or negative-) on the froth bubble as a result of the surfactant , can be used with the ionic charge in the coagulants to create neutral environment for particles. Making particles non polar is important for hydrophobicity and the attachment of solid particles to other solid particles causing flocculants. The flocculated particles will then attach to bubbles and rise to the surface in the water tank.
1. 表面活性剂产生的泡沫上携带有离子电荷（正电荷+或负电荷-），可以同凝结剂中的离子电荷一同营造一个粒子系统的中性环境。使粒子系统整体不带电对于保持疏水性，使固态粒子依附在凝结剂产生的固态粒子上都有很重要的作用。之后絮凝粒子将依附在泡沫上，浮升至水槽表面。
2. With froth technology 3 to 10 % by volume of bubbles can be added to the waste water. With DAF, the maximum bubble concentration is 0.7 to 0.9 %. Froth technology will likely provide a better separation of the solids in the waste water than DAF technology
2. 在泡沫浮选技术中，约 3-10%体积的气泡将被添加到废水中，而在溶气浮选技术中，气泡浓度最大可达到 0.7-0.9%。比较可见，泡沫浮选技术将可能比溶气浮选技术提供一个更好的水中固体分离效果。
3. The Froth technology significantly reduces the amount of water that needs to be recycled. As a result, the energy used in Froth systems is much less than in DAF systems. For Drinking water treatment , DAF systems require 10 to 15% of the treated water to be recycled where Froth technology only requires 3 to 5%. For Industrial waste water treatment , DAF systems require 50 to 100% recycle and Froth technology requires only 10%.
3. 泡沫浮选技术显著地减少了回流的水分量，因此其耗能比 DAF 系统低很多。在饮用水处理中，DAF 系统需要将处理水的 10-15%回流，而泡沫浮选仅需要 3-5%。在工业废水处理中，DAF 系统的回流水量达到了 50-100%，而泡沫浮选仅需 10%。
4. For Industrial Water treatment ,the hydraulic loading rate for the design of the flotation tankage is twice as high for DAF flotation systems compared to Froth Flotation systems. As a result tankage is much larger in DAF systems than Froth technology systems
4. 在工业水处理中，DAF 浮选系统的浮选槽设计水力负荷量是泡沫浮选系统的两倍，因此，DAF 浮选槽比泡沫浮选槽要大。
5. The operating cost of Froth Flotation Systems is significantly higher than DAF systems because of the chemistry cost for the surfactant in Froth systems.
5. 考虑到泡沫系统中表面活性剂的化学品消耗，泡沫浮选系统的经营费用比 DAF 系统要高很多。

Froth Flotation- Energy Efficient with lower recycle flow and No Compressed Air requirements.



泡沫浮选-因产生少量的回流水而节能，且没有压缩空气的需求



Step 2: Filtration using a Membrane Precoat

步骤 2：应用预涂层技术的过滤膜

1. The Precoat technology allows for the membrane skin layer to be customized or changed to match the best characteristics of the forces that will cause the colloidal solids in the water to attach to the membrane skin Layer (precoat). As the water passes through the precoat layer, the colloidal solids in the water attach to the fine powder in the precoat . The three key forces that make colloidal solids attach to powder in the precoat are Van der Waal forces, Hydrophobicity and Electrostatic forces.

1. 预涂层技术可以定制或更换膜表层以达到元件的最佳性能，使水中的胶态固体依附到膜表层（预涂层）上。水通过预涂层时，胶态固体将粘附在预涂层的细粉上，影响预涂层中胶态固体与粉末粘附的三个关键分别是范德华力、疏水性和静电力。

2. Loading / flux rate is much higher for the precoat technology . Based on the pilot testing, the flux rate is 10 times higher than typical membranes. This higher flux rate makes it economically viable to use more durable yet more costly membrane materials such as Stainless Steel. As a result the membrane base (tube) can last much longer with the only change being the membrane skin layer (precoat) .

2. 预涂层技术的加载速率/流量都很高，根据引导测试显示，流量比典型膜高 10 倍。它的高流量为其应用不锈钢等耐用但昂贵的膜材料在经济提供了可行性，同时也可以使膜单元（管件）持续更久。

3. Need for chemistry ,such as acids and bases, to remove fouling from the membrane skin layer, is reduced significantly but there is a need to add a precoat material in the amount of 20 to 50 mg/l of water being treated.

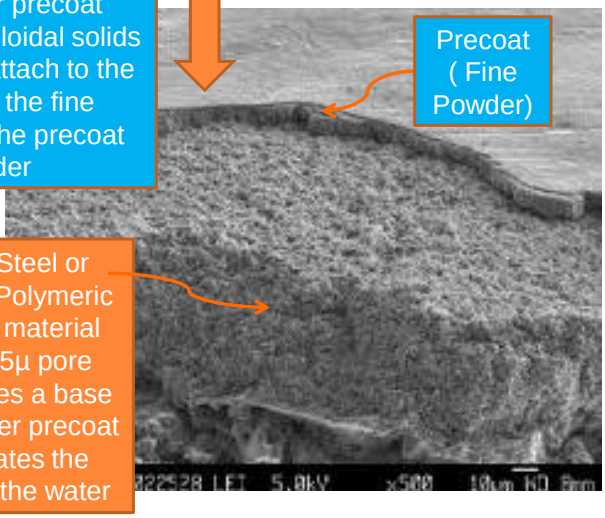
3. 对于酸碱等降低膜表层污染的化学品需求显著降低，但需要在处理水体中添加 20-50mg/l 的预涂层材料。

4. The precoat technology for membranes will eliminate the typical membrane requirement of limiting the flux (flow rate), known as the threshold flux, and the pressure levels. In existing membranes, threshold flux rate and pressure are limited to reduce rapid fouling of the membranes. The precoat technology concept encourages the precoat to have fouling (attachment of colloidal particles). Therefore precoat membranes can be operated at higher flux rates and pressure. Increases in flux rate and pressure could lead to significantly greater efficiencies.

4. 膜组件预涂层技术将排除典型膜对流量（临界流量）和压力水平的限制要求。在目前的膜组件中，考虑其迅速的膜污染，需要对临界流量和压力进行限制，而预涂层技术鼓励预涂层污染（附着胶态固体），因此预涂层膜组件可以在高流量高压力的情况下运作，流量和压力的升高将会使效率得到显著提升。

Precoat to Create Temporary Membrane Skin Layer and Remove When Fouled

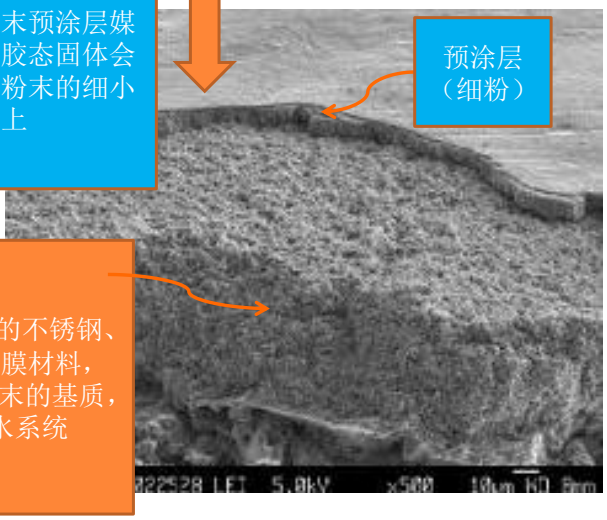
As water passes through the powder precoat media, the colloidal solids in the water attach to the surface of the fine granules in the precoat powder



Stainless Steel or Ceramic or Polymeric membrane material with 1µ to 5µ pore size. Provides a base for the powder precoat and facilitates the drainage of the water

预涂层形成的暂时膜表层，当其被污染时可分离预涂层

当水体通过粉末预涂层媒介时，水中的胶态固体会吸附在预涂层粉末的细小颗粒上



孔径为1µ- 5µ的不锈钢、陶瓷或高分子膜材料，提供预涂层粉末的基质，并促进排水系统

Application of Nanflotation Technology

纳米浮选技术的应用

1. Lake waters for the removal of algae, solids(TSS), colloidal solids, fertilizers , organics (Total Organic Carbon-TOC) and metals

1. 从湖泊中去除藻类，固体（总悬浮物），胶质固体，肥料，有机物（总有机碳）和金属

2. River Water for the removal of solids ,colloidal solids, metals, fertilizer, and organics (TOC)

2. 从河流中去除固体，胶质固体，金属，肥料和有机物（总有机碳）

3. Pharmaceutical waste waters and the removal of vegetative solids, colloidal solids, organics (TOC), Chemical Oxygen Demand (COD),

3. 从制药废水中去除营养性固体，胶质固体，有机物（总有机碳）和化学需氧量（COD）

4. Pulp and Paper waste water and the removal of solids (TSS), colloidal solids, organics (TOC) and production of high quality water for reuse

4. 从造纸废水中去除固体（总悬浮物），胶质固体，有机物（总有机碳），并产生可重复利用的优质水

5. Pig Farms waste water and the removal of solids (TSS), colloidal solids, organics, ammonia, phosphates, metals and production of high quality water for animal drinking water.

5. 从养猪场废水中去除固体（总悬浮物），胶质固体，有机物，氨水，磷酸盐和金属，并且产生适合动物饮用的优质水

6. Mines tailing pond wastewater at coal mines or metal mines for the removal of colloidal solids for water discharge to rivers and lakes or water reuse in the mine of for a water source to produce drinking water for the community near the mine or serving the mine.

6. 从煤矿或金属矿的尾矿废水中去除胶质固体，以达到向河流和湖泊排放的标准，或者在矿区实现水的再利用，为矿区附近或服务于矿区的村落提供饮用水

7. Breweries' waste water and the removal of solids, organics (TOC) and COD for discharge into rivers and lakes

7. 从啤酒厂废水中去除固体，有机物（总有机碳）和化学需氧量，达到向河流和湖泊排放的标准

8. Tanneries' waste water and the removal of solids, organics (TOC) and COD. (Note Colour is a problem in tanneries and Nanoflotation could possibly remove colour but would have to be tested for this application)

8. 从制革厂废水中去除固体，有机物（总有机碳）和化学需氧量。（注意：色度是制革工艺中的一个问题，在这种情况下纳米浮选技术可能可以降低废水中的色度，但还须进行测试）

9. Chemical Factories waste water and the removal of colloidal solids, organics (TOC and COD) and metals for discharge to rivers or lakes or reuse in the factory

9. 从化工厂废水中去除胶质固体，有机物（总有机碳和化学需氧量）和金属，达到向河流和湖泊排放的标准或者在工厂中再利用

10. Fertilizer factories waste water and the removal of colloidal solids, organics (TOC and COD) and metals for discharge to rivers or lakes or reuse in the factory

10 从化肥厂污水中去除胶质固体，有机物（总有机碳和化学需氧量）和金属，达到向河流和湖泊排放的标准或者在工厂中再利用

11. Effluent from sewage treatment plants to provide source water for drinking water facilities. In this application the standard effluent from a sewage treatment plant that had primary settling or activated sludge treatment could then be treated with nanoflotation followed by some method of disinfection (chlorine and /or UV) which would then produce drinking water. This would be an excellent application in drought stricken areas or limited fresh water areas.

11. 将污水处理厂出水用作饮用水水源。在这种情况下污水处理出水的标准在于考察其主要沉淀物或活性污泥，其出水经过纳米浮选技术和一些消毒工艺（氯气和紫外线消毒共同使用或者只用一种），以达到饮用水标准。这在干旱地区或淡水匮乏区将是一个极好的应用。

12. Pure water systems which are used in the pharmaceutical industry, the power generation industry or any industry that produces steam through the use of a boiler, and the computer wafer and chip industry. In this application reverse osmosis (RO) is typically used to produce the pure water. In every RO system there is a requirement to pre-treat the water. Typically the pre-treatment has been a sand or multimedia (garnet, sand, anthracite) filter. The requirement was that the water after pre-treatment had to have a Silt Density Index (SDI) less than 5. SDI relates to the clarity of the water. The purpose of the pre-treatment was to remove the colloidal solids so RO membranes will last longer. This standard has changed over the last 10 years where the requirement now is to have the treated water with an SDI less than 3. To accomplish this SDI level Ultra filtration (UF) membranes are used instead of the multimedia filters. The lower cost, low energy option to UF is Nanoflotation. Nanoflotation followed by RO can produce pure water. Test results on the Nanoflotation showed SDI's less than 1

12. 将纯水系统应用于制药行业、发电行业、或其他使用锅炉产生蒸汽的行业、以及电脑晶片和芯片制造行业。这些行业多使用反渗透膜（RO）产生纯水，任何的反渗透系统都对入水的预处理有一定要求，目前常见的预处理方法是用砂质或多介质（矿物质、砂质、煤质）过滤器，处理的要求是使其出水的污染指数（SDI）小于 5。SDI 值与水体的澄清程度有关，而预处理的目的在于去除水中的胶质固体以确保反渗透膜长期使用。在过去的 10 年内，这项标准已经改为 SDI<3。为了使 SDI 值达到这样的水平，可以用超滤膜（UF）代替多介质过滤器。纳米浮选技术比超滤膜的成本更低，能耗也更低，在纳米浮选后进行反渗透会产生 SDI 值小于 1 的纯水。

13. Drinking water systems where the source water is from a lake or river and possibly brackish waters (total dissolved solids are in the 2000 to 3000 mg/l range). Nanoflotation will provide high quality water that would require disinfection as a final treatment method. Depending on the TDS level, RO may also be required on the effluent from the Nanoflotation system.

13.以湖泊或河流，甚至是微咸水（总溶解性固体介于 2000 – 3000mg/l 范围内）作为饮用水水源系统。通过纳米浮选技术后最终水体进行消毒处理，可以产生优质的出水。而根据其 TDS 水平的高低，可能需要在纳米浮选系统后进行反渗透处理。

Treatment of waste waters for discharges into Rivers of Lakes. The significant benefit of nanoflotation is that it also raises the dissolved oxygen (DO) level significantly. As a result, with nanoflotation's ability to remove colloidal solids and reduce organics, it has the added benefit of increasing the DO levels in the discharge going into an oxygen depleted river or lake.

处理废水最终排放至河流湖泊中。纳米浮选技术一项优势是可以显著提高水体中的溶解氧（DO）水平。纳米浮选技术可以去除水体中的胶质固体和有机物，也提高了排放至河流湖泊水体中溶解氧的水平。