



AMS Specialty Nanofiltration Membranes in Gold Production

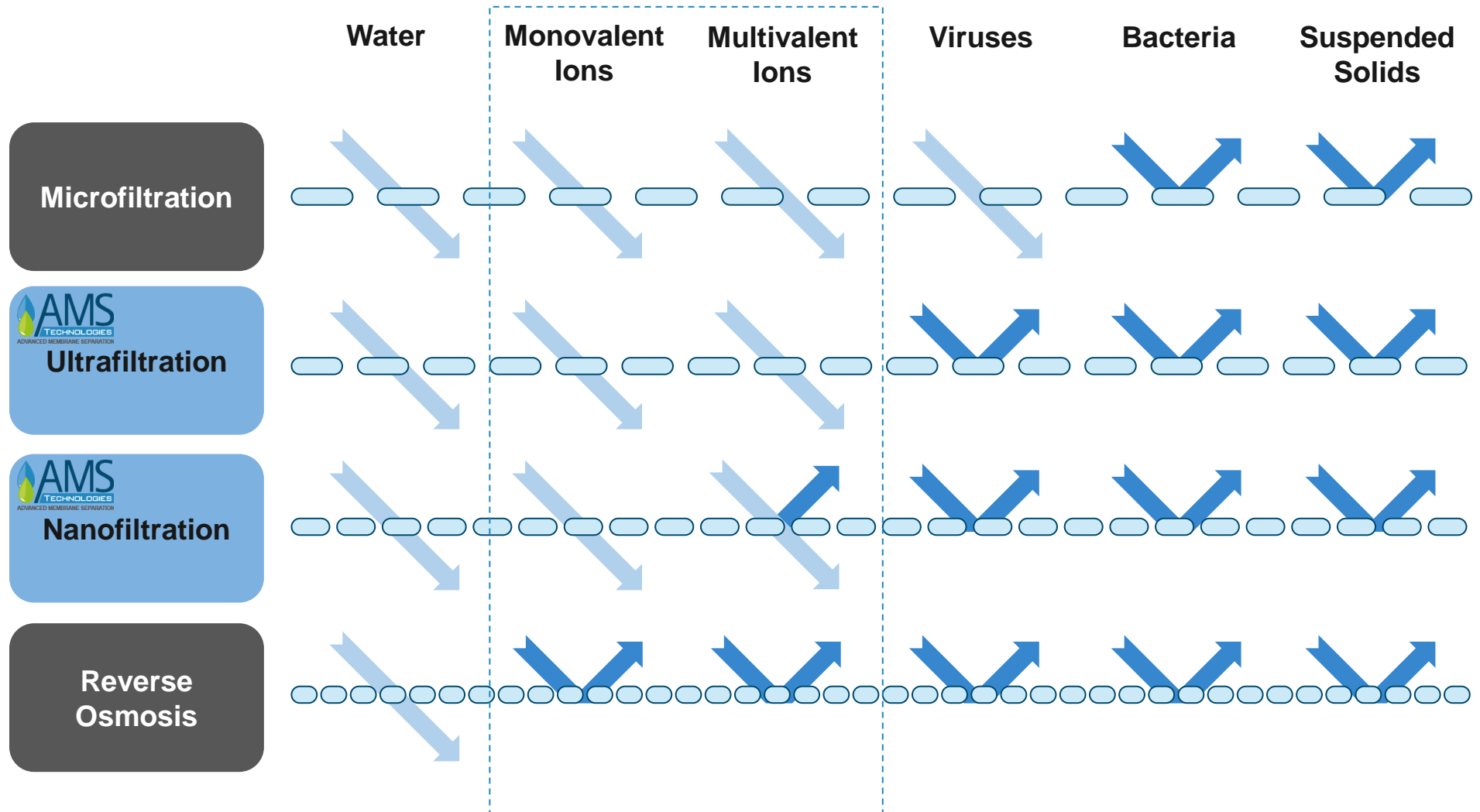
- ✓ AMS Technologies is a commercial membrane manufacturer that specializes in the treatment of in-process and wastewater streams
- ✓ Following a decade of cutting edge research, our team of scientist developed a unique line of highly durable nanofiltration and ultrafiltration membrane products enabling the treatment of aggressive industrial streams with great benefits to clients

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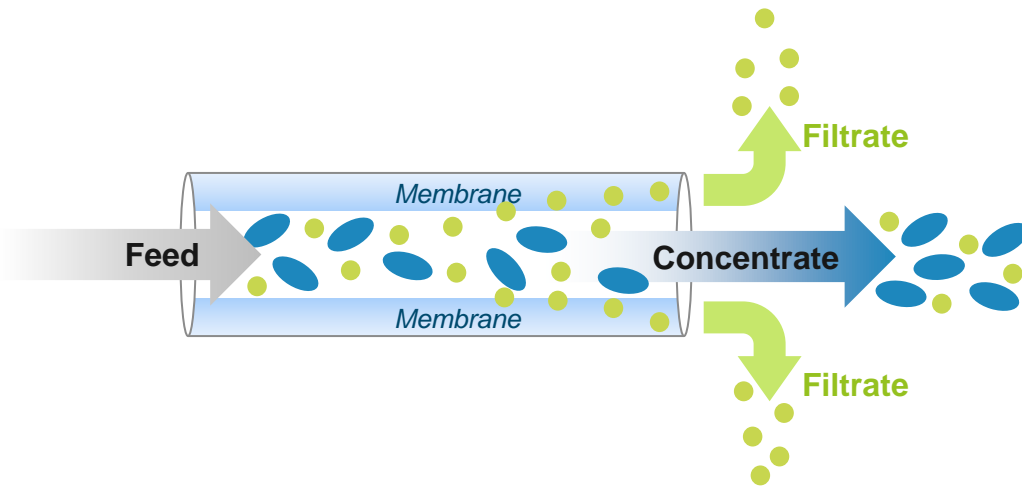
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Nanofiltration (NF) membranes have rejection selectivity: allowing monovalent and blocking multivalent components



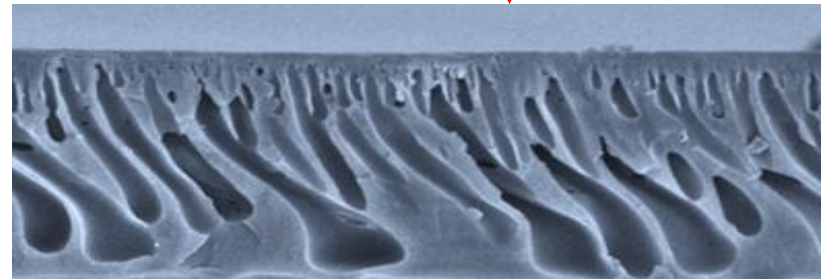
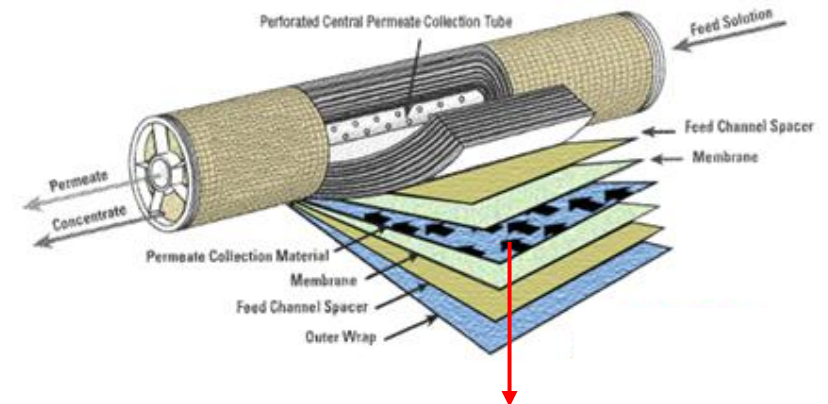
AMS membranes uniquely designed for metal complex separation under aggressive conditions

NF used to recover acid and concentrate metals

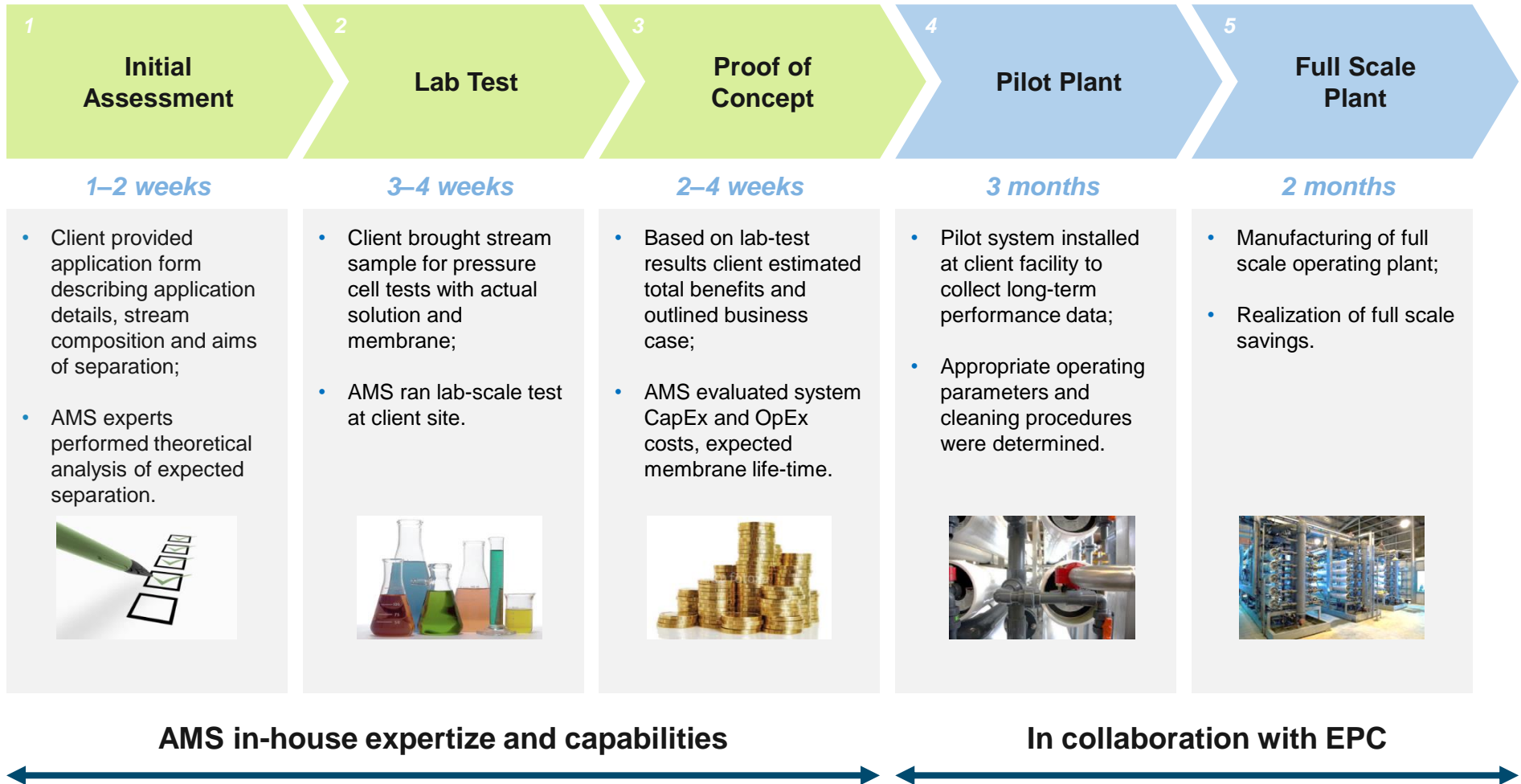


- Small monovalent molecules (e.g. water, acid, caustic)
- Multivalent metal components, organics (e.g. CuSO_4 , NiSO_4)

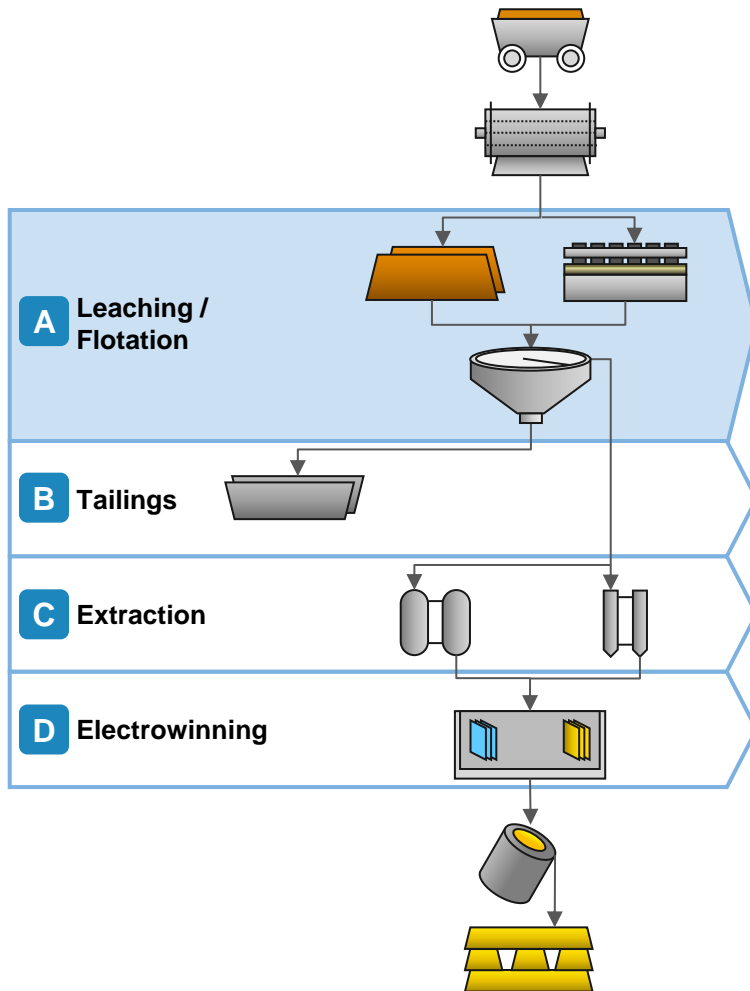
Spiral wound modules maximize membrane area per module



Project approach consists of several stages for better assessment and project risk mitigation

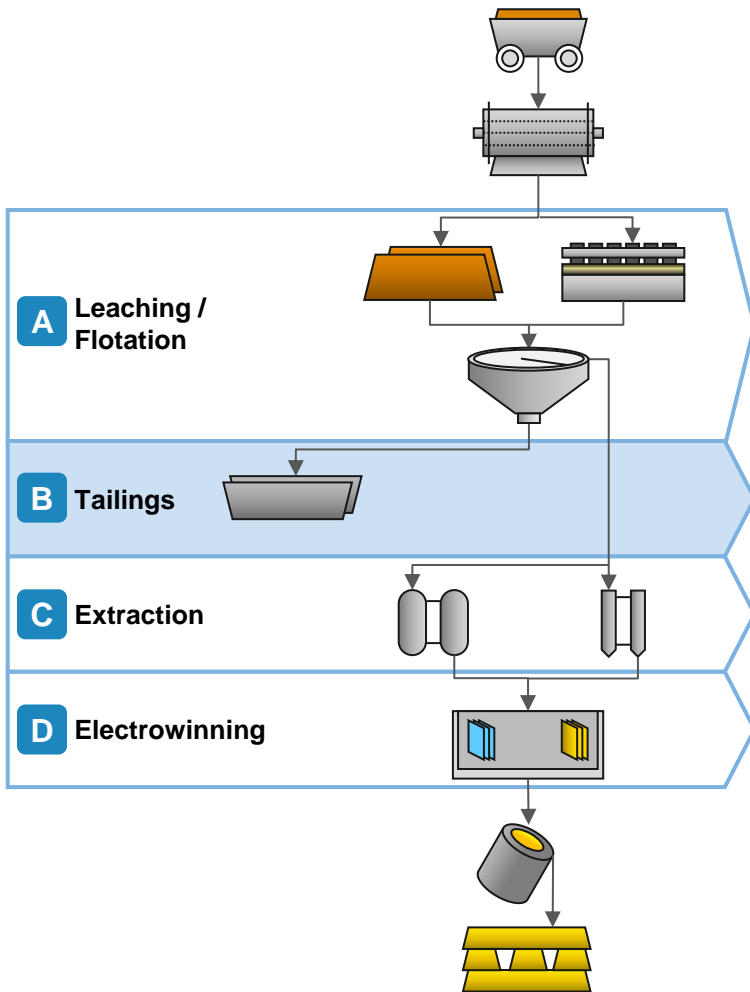


Using membranes to concentrate leach solution allows increasing throughput



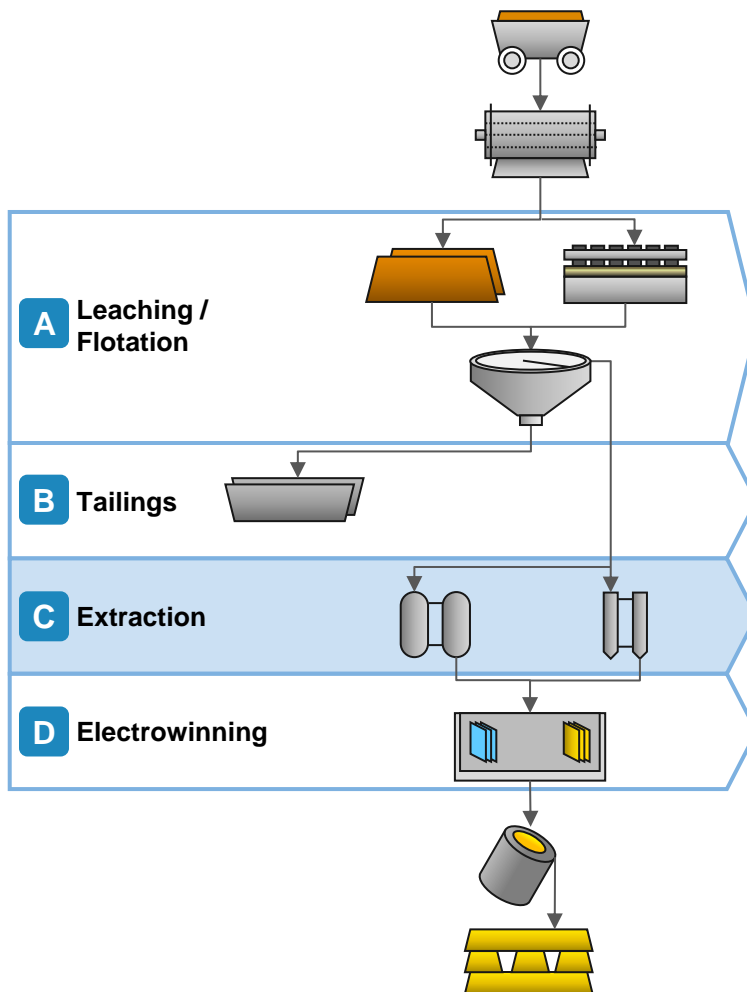
	Aim	Process	Input	Outputs
1	Reduce volume	RO	Clarifier OF	Clean water • Concentrated cyanides solution •
2	Separate base metals	NF	Clarifier OF	Au/Ag-cyanides solution • Concentrated Cu/Co/Zn-cyanides • solution
3	Extract base metals	NF > SART	Clarifier OF	Au/Ag-cyanides solution • Cu/Co/Zn-sulfide precipitate • Free cyanide solution •

Environmental concerns are efficiently addressed through decontamination of tailing ponds water



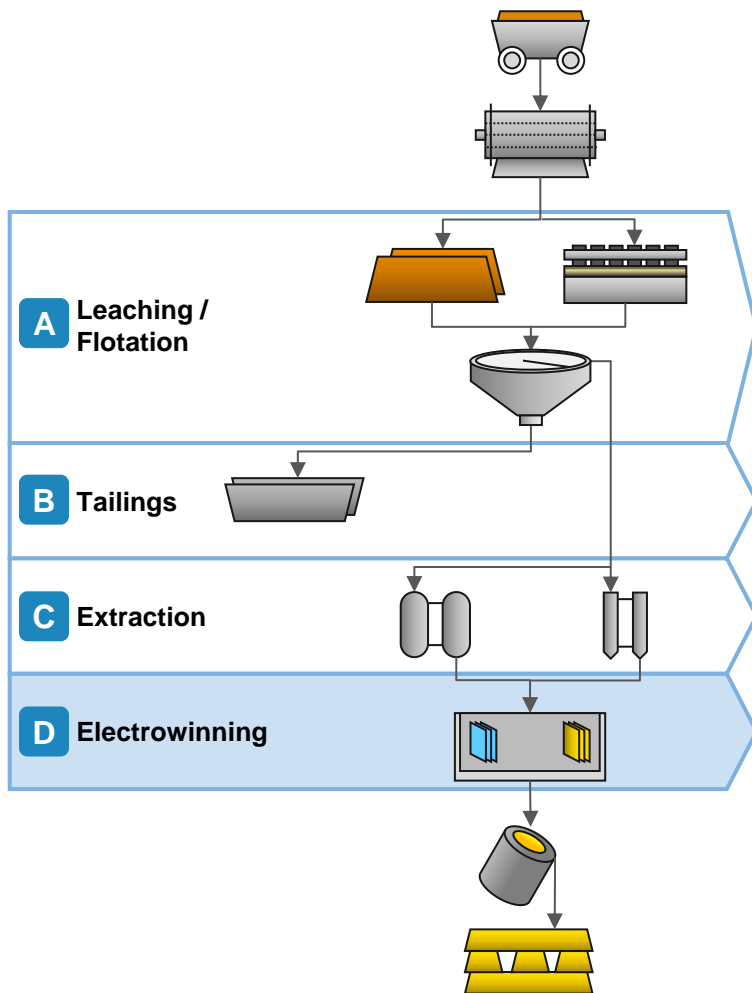
	Aim	Process	Input	Outputs
1	Enable water discharge	RO	Tailings pond water	Clean water for re-use or discharge Concentrated impurities solution
2	Recover cyanide	RO	Tailings pond water	Clean water for re-use or discharge Free cyanide solution

Membrane treatment optimizes efficiency and economics of both resin- and carbon-based extraction processes



	Aim	Process	Input	Outputs
1	Reduce eluate volume	RO	Eluate	<ul style="list-style-type: none"> Concentrated Au/Ag-cyanides solution; Clean water for re-use or discharge.
2	Reduce barren volume	NF	Barren solution	<ul style="list-style-type: none"> Concentrated impurities; Clean Au/Ag-cyanides solution.
3	Acid recovery	NF	Spent acid washing solution	<ul style="list-style-type: none"> Clean acid (HCl) for re-use in washing; Concentrated impurities (e.g. Ca, Cu, Mg) from washing
4	Preheat reagents recovery	NF	Spent preheat solution	<ul style="list-style-type: none"> Clean caustic-cyanide solution; Concentrated impurities.

Electrolyte recovery and purification greatly improves quality and performance of electrowinning process



	Aim	Process	Input	Outputs
1	Cyanide recovery	NF	Spent electrolyte	<ul style="list-style-type: none"> Free cyanide and Au/Ag-cyanides solution; Concentrated multivalent impurities.