

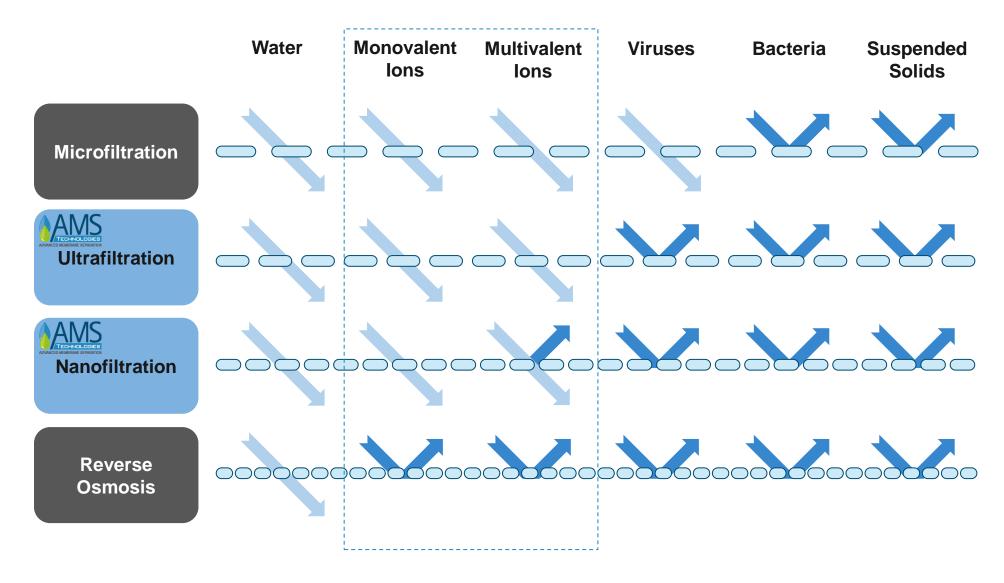
## AMS Specialty Nanofiltration Membranes in Gold Production

- ✓ 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

#### Visit us on: www.amsmembrane.com

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



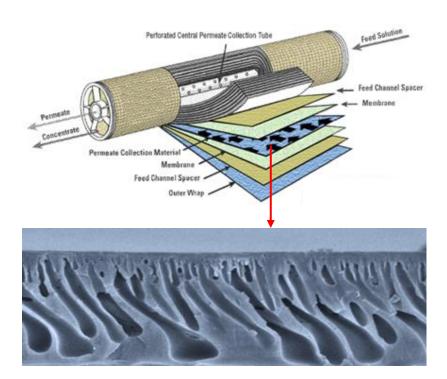
## AMS membranes uniquely designed for metal complex separation under aggressive conditions

#### NF used to recover acid and concentrate metals

# Filtrate Membrane Concentrate Membrane Filtrate

- Small monovalent molecules (e.g. water, acid, caustic)
- Multivalent metal components, organics (e.g. CuSO<sub>4</sub>, NiSO<sub>4</sub>)

### Spiral wound modules maximize membrane area per module



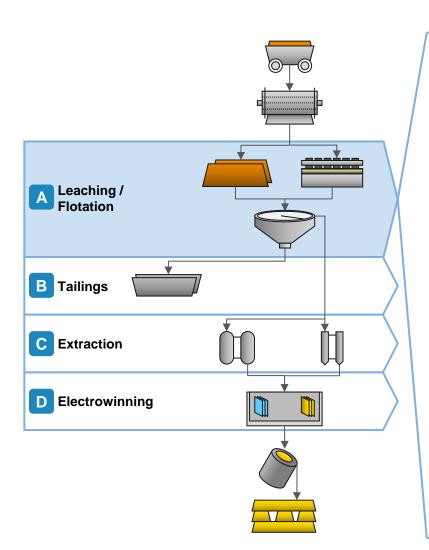
## Project approach consists of several stages for better assessment and project risk mitigation

Initial Proof of **Full Scale Pilot Plant Lab Test** Concept **Plant** Assessment 1-2 weeks 3-4 weeks 2-4 weeks 3 months 2 months Client provided Client brought stream Pilot system installed Manufacturing of full Based on lab-test application form sample for pressure results client estimated at client facility to scale operating plant; describing application cell tests with actual total benefits and collect long-term details, stream performance data: solution and outlined business Realization of full scale composition and aims membrane; case: savings. of separation; Appropriate operating AMS ran lab-scale test AMS evaluated system parameters and AMS experts at client site. CapEx and OpEx cleaning procedures performed theoretical costs, expected were determined. analysis of expected membrane life-time. separation.

AMS in-house expertize and capabilities

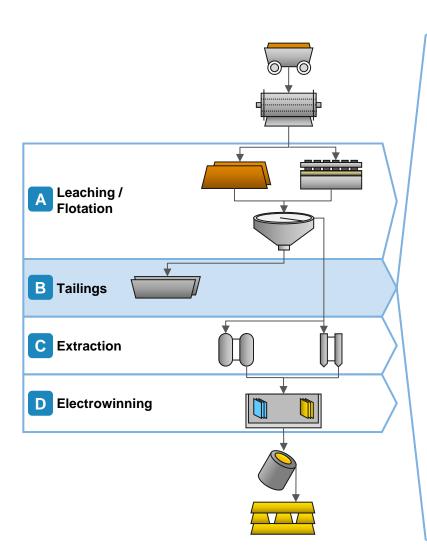
In collaboration with EPC

## Using membranes to concentrate leach solution allows increasing throughput



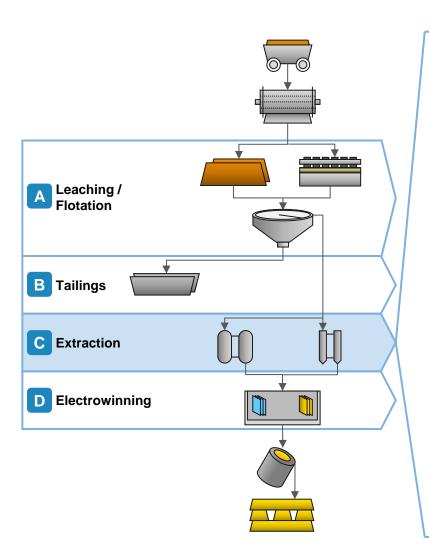
	Aim	Process	Input	Outputs
1	Reduce volume	RO	Clarifier OF	Clean water • Concentrated cyanides solution •
2	Separate base metals	NF	Clarifier OF	Au/Ag-cyanides solution • Concentrated Cu/Co/Zn-cyanides • solution
3	Extract base metals	NF > SART	Clarifier OF	Au/Ag-cyanides solution • Cu/Co/Zn-sulfide precipitate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

## Environmental concerns are efficiently addressed through decontamination of tailing ponds water



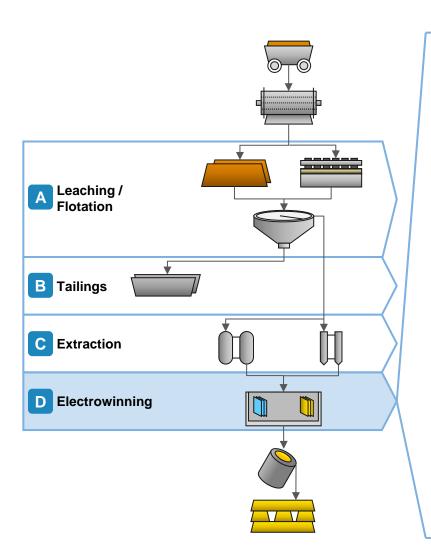
	Aim	Process	Input	Outputs
1	Enable water discharge	RO	Tailings pond water	Clean water for • re-use or discharge Concentrated impurities solution •
2	Recover cyanide	RO	Tailings pond water	Clean water for re-use or discharge Free cyanide solution •

## 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> <li>Concentrated Au/Ag-cyanides solution;</li> <li>Clean water for re-use or discharge.</li> </ul>
2	Reduce barren volume	NF	Barren solution	<ul><li>Concentrated impurities;</li><li>Clean Au/Ag-cyanides solution.</li></ul>
3	Acid recovery	NF	Spent acid washing solution	<ul> <li>Clean acid (HCI) for re-use in washing;</li> <li>Concentrated impurities (e.g. Ca, Cu, Mg) from washing</li> </ul>
4	Preheat reagents recovery	NF	Spent preheat solution	<ul> <li>Clean caustic-cyanide solution;</li> <li>Concentrated impurities.</li> </ul>

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



Aim	Process	Input	Outputs
1 Cyanide recovery	NF	Spent electrolyte	Free cyanide and Au/Ag-cyanides • solution; Concentrated multivalent • impurities.