

UPDATE ON LARGE-SCALE
CHEMICAL PROCESSING
FOR NEUTRON CAPTURE,
AND ACCELERATOR DRIVEN
PRODUCTION OF ^{99}MO



PETER TKAC

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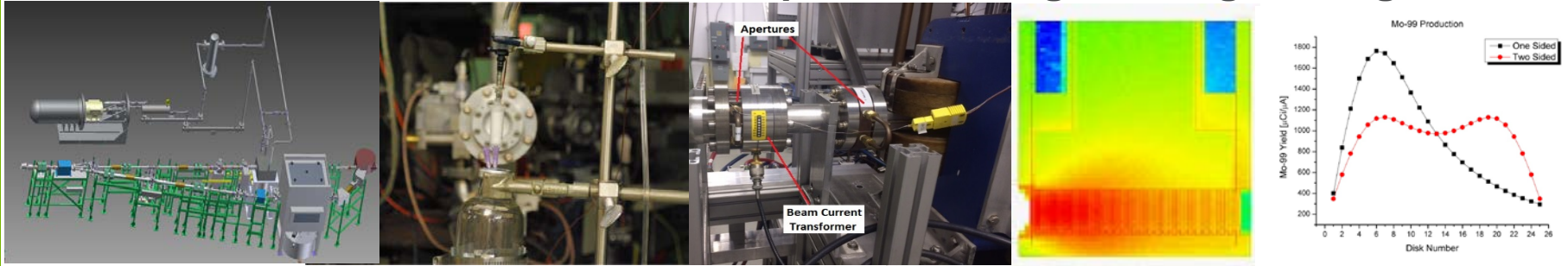


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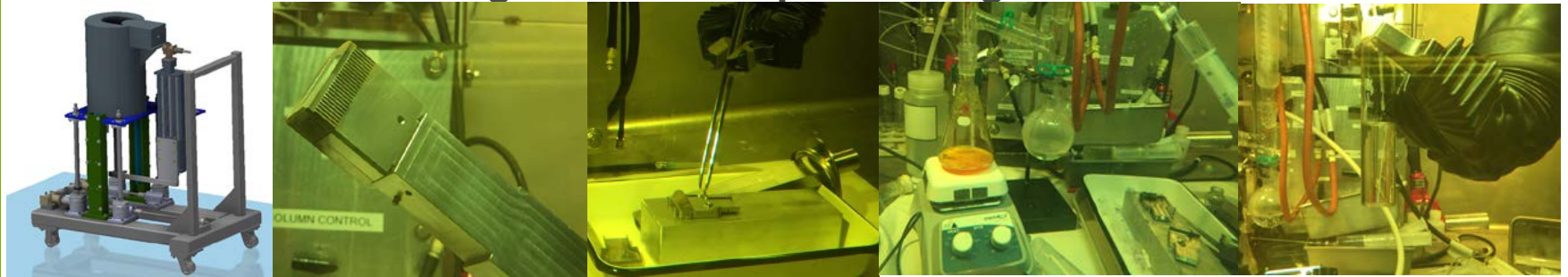
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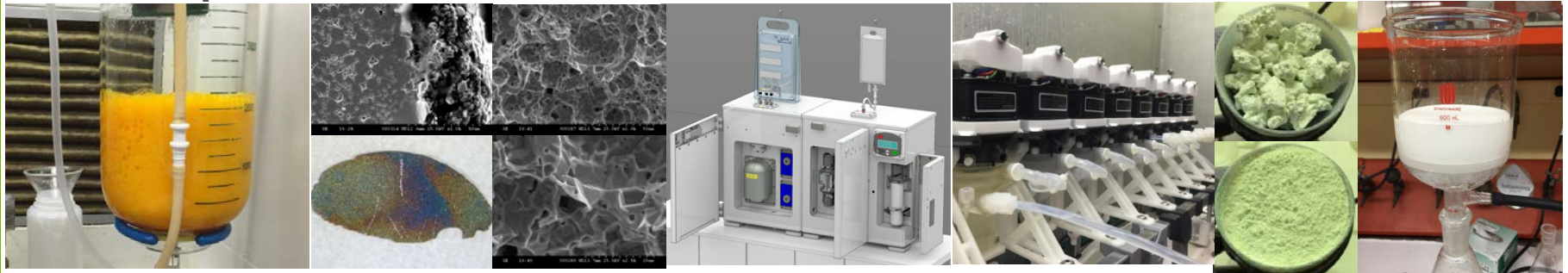
Irradiations, radiation dose, beam transport, shielding and target design, MCNPX



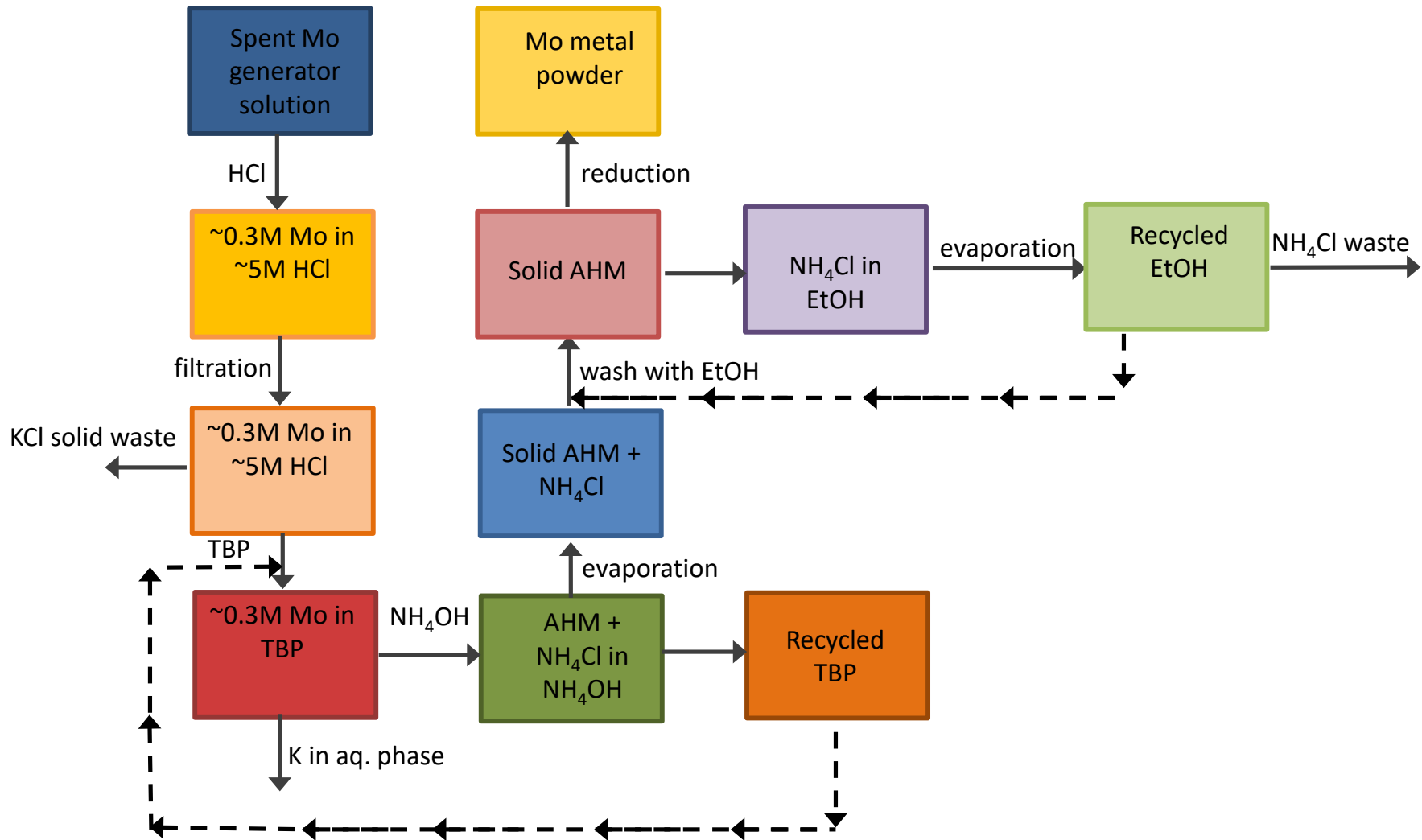
Post-irradiation handling and hot-cell processing



Chemical processes R&D



MOEX RECYCLE PROCESS - SOLVENT EXTRACTION



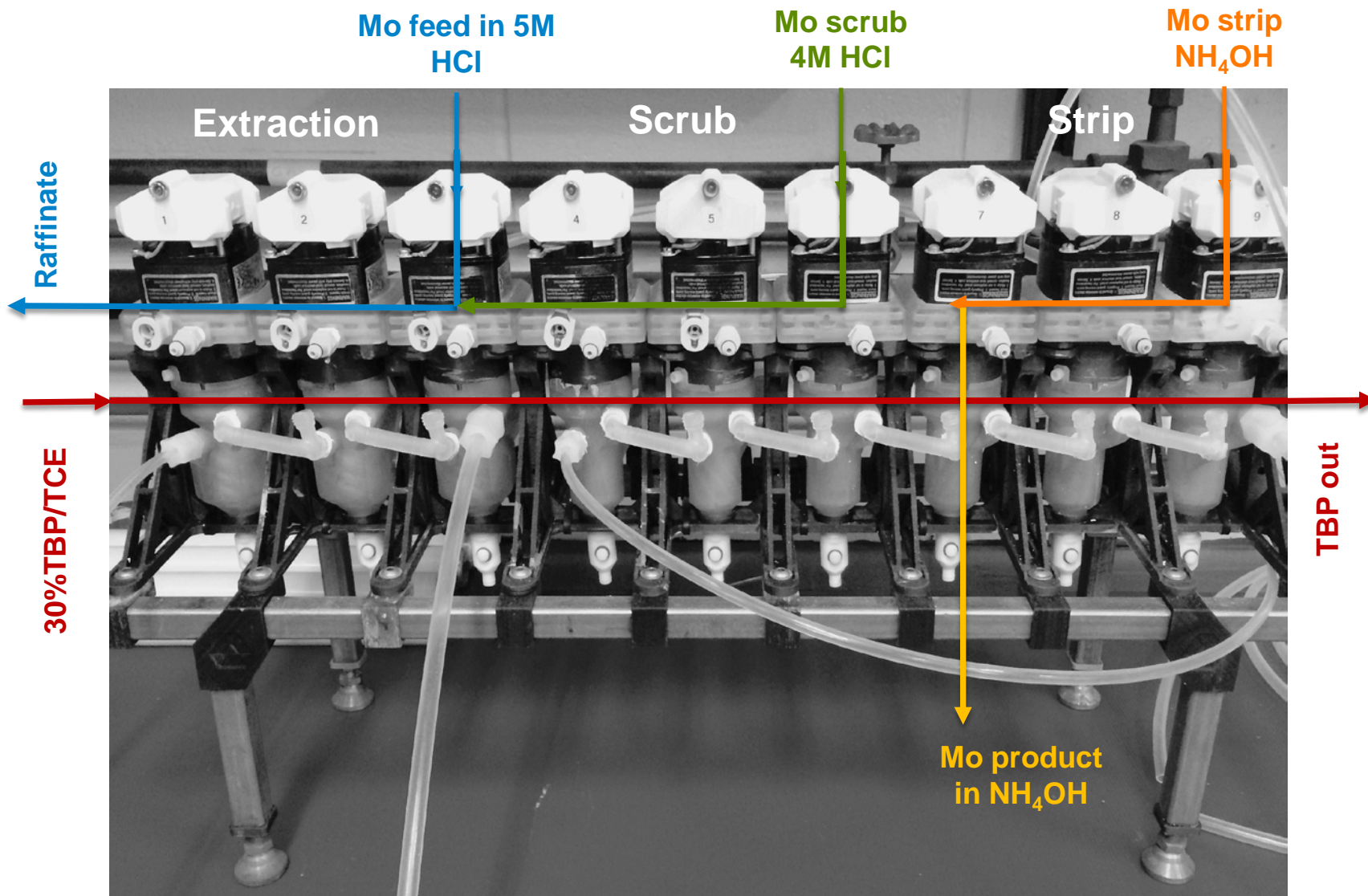
UPDATE ON CENTRIFUGAL CONTACTOR WORK

Tests using 2-cm contactor

- Performed multiple 9-stage runs with 3D-printed plastic contactor
- Incorporated extended residence time stages for strip
- Added cooling plates to reduce heat transfer between motor and contactor body
- Re-designed coupling between motor and rotor for better stability
- Re-designed inter-stage lines
- Discovered that acrylic material is not suitable for long-term use

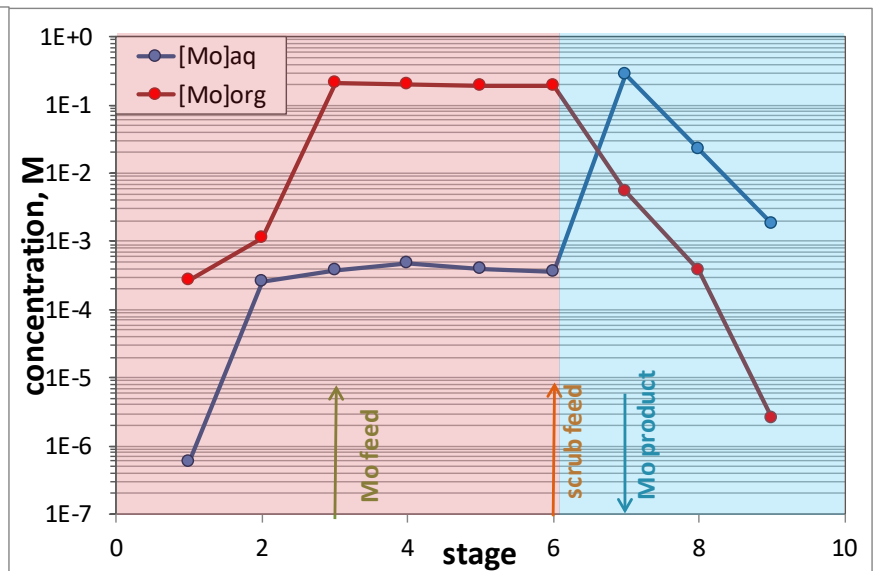
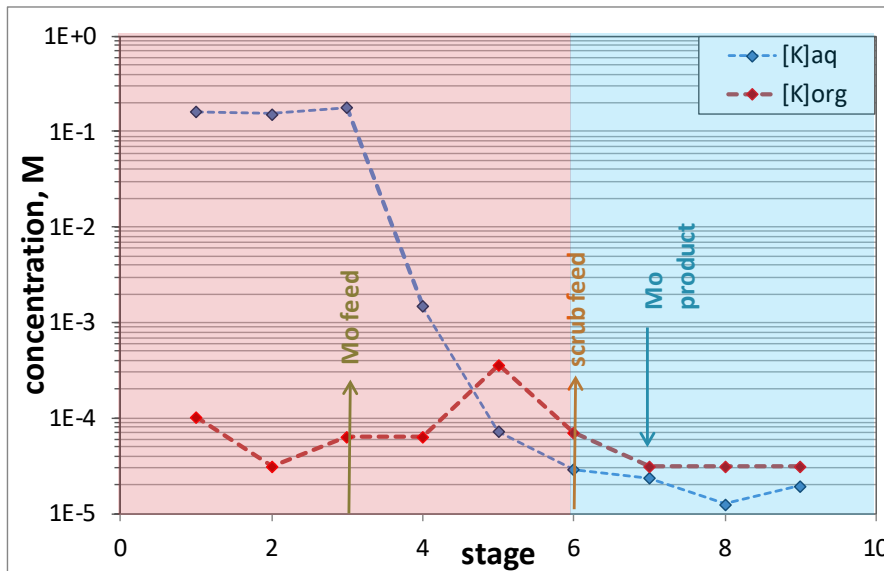


UPDATE ON CENTRIFUGAL CONTACTOR WORK



PROCESSING MURR-IRRADIATED SAMPLE

	EXTRACTION		FEED↓			SCRUB↓			STRIP↓		
	R	A1	A2	A3	A4	A5	P	A7	A8		
<<<Raf										<<< strip	
	stage 1	stage 2	stage 3	stage 4	stage 5	stage 6	stage 7	stage 8	stage 9		
TBP>>>										TBP out>>>	
	O2	O3	O4	O5	O6	O7	O8	O9	TBP out		



Mo feed: 12mL/min
Mo scrub: 10mL/min

TBP: 20mL/min
Strip: 12mL/min

O/A ex: 0.91
O/A scrub: 2.0
O/A strip: 1.67

PROCESSING MURR-IRRADIATED SAMPLE

element	Mo in KOH mg-Me/kg-Mo	Mo feed-HCl mg-Me/kg-Mo	Product (NH ₄ OH) mg-Me/kg-Mo
Na	688	643	151
Mg	32.5	<DL	18.7
Si	976	391	114
P	1286	<DL	250
Ti	40.2	29.2	30.8
Fe	<DL	<DL	<DL
Cu	2.57	2.14	0.96
Zn	<DL	<DL	6.11
Zr	<DL	<DL	<DL
Nb	4.02	3.37	3.99
Sn	3.88	3.85	6.38
Cs	0.27	0.45	0.79
W	<DL	3.77	10.1
K	2002427	419263	34.6

SCALE UP TO 3CM CONTACTOR



RECOVERY OF MO BY SOLVENT EXTRACTION

Total Mo in KOH solution processed: ~9L

Total Mo feed processed: ~45L

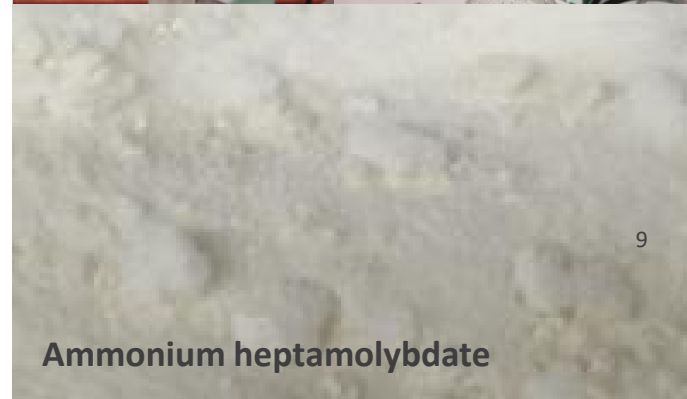
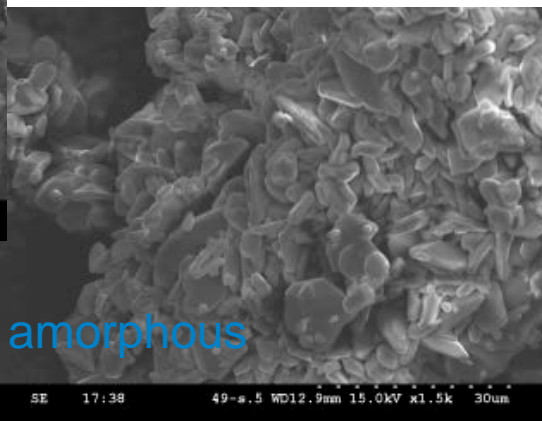
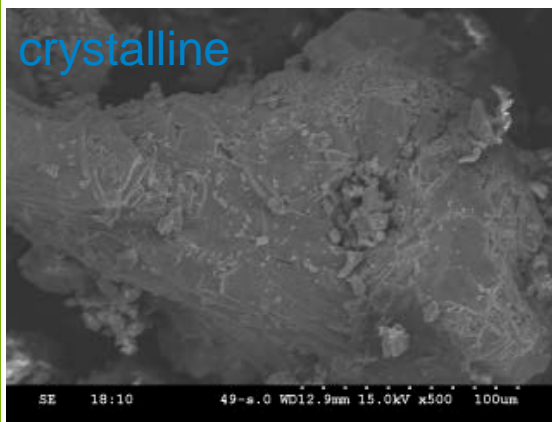
Total AHM recovered: ~2.7kg

AHM Size distribution

~10% fines (<45 μ m)

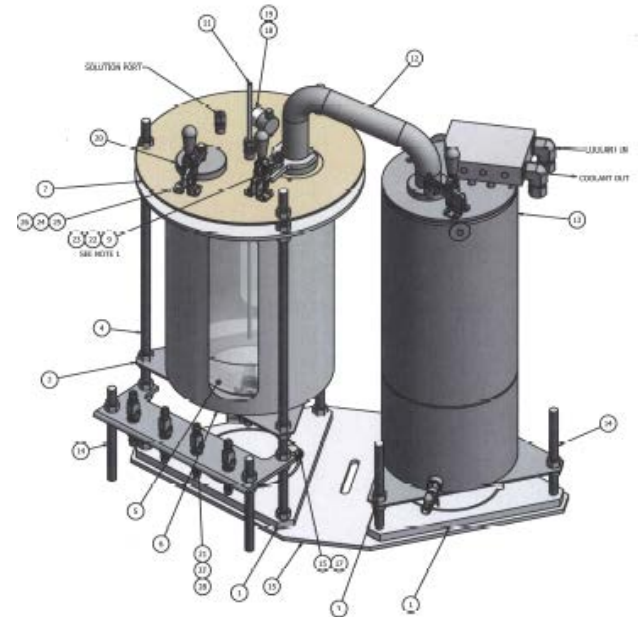
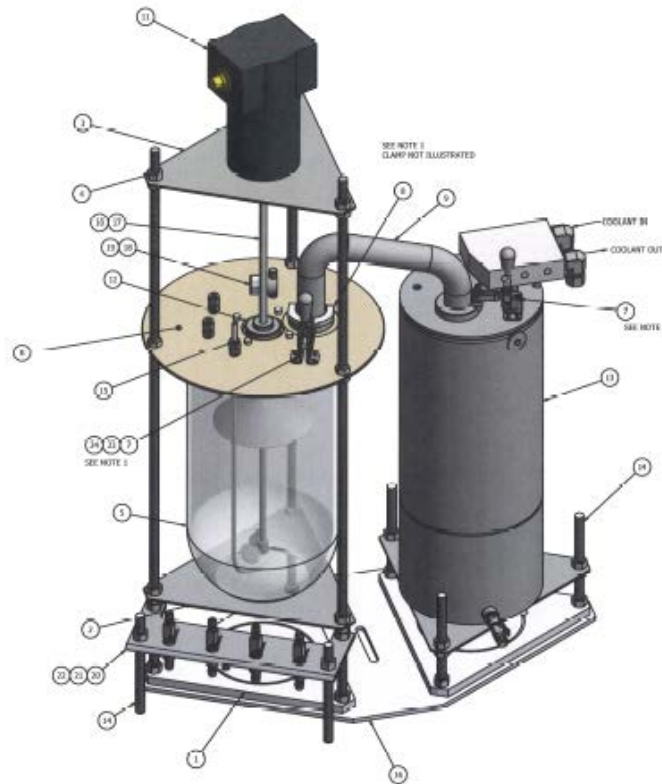
~90% 45-425 μ m

Amorphous material occasionally



FULL-SCALE DISSOLVER FOR HOT CELL OPERATIONS

- Dissolution of up to 600g of Mo
- Vigorous and exothermic reaction
- ~1L of water condensed in 15min ~2.6kW
- Optimized processing time from 8hrs to ~2.5-4hrs



FULL-SCALE DISSOLVER FOR HOT CELL OPERATIONS



DISSOLUTION ASSEMBLY



Steam line for cleaning

Peroxide in

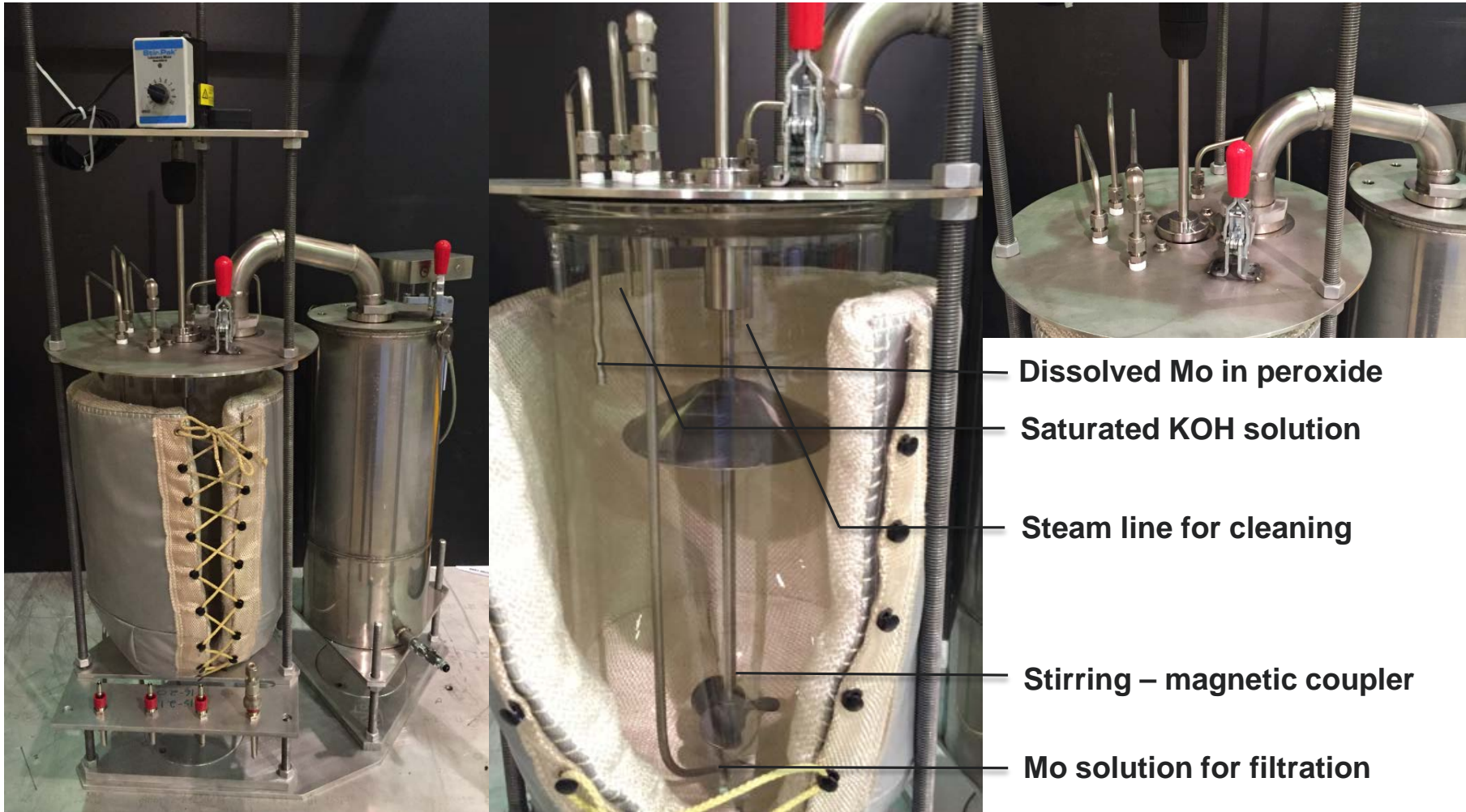
Plug for disks port

Saturated KOH solution



Disks insert

EVAPORATION ASSEMBLY



FUTURE PLANS

Mo Recycle

- Leach testing of potential alloys and thermoplastics for centrifugal contactor (PEEK, PP, PVDF, Inconel)
- Long-term testing of materials in contactor with Mo-HCl-TBP-TCE
- Manufacture full-scale 3-cm contactor

Dissolution

- Testing the dissolution apparatus for hot cell operations
- Water run to check solution transfers
- Dissolution of several hundred gram batches of sintered Mo disks

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QUESTIONS?