

GE Power & Water

Water & Process Technologies

ABMet Selenium Removal

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imagination at work

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ecomagination

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What is Selenium?

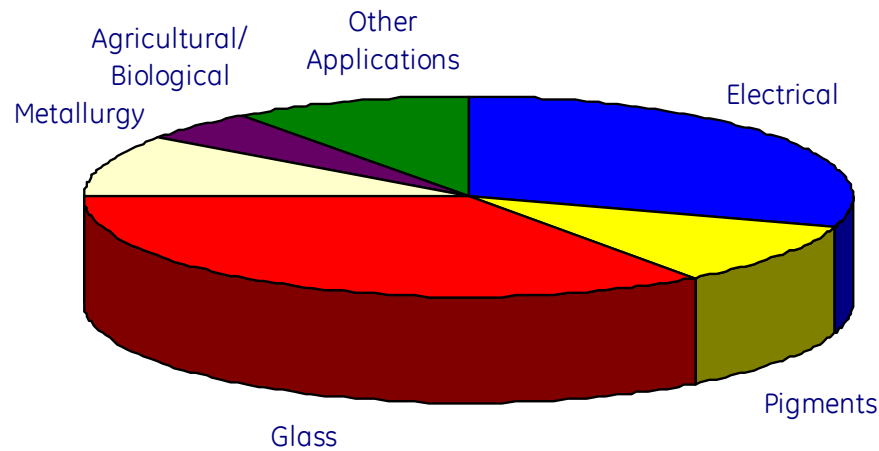
Periodic Table of the Elements

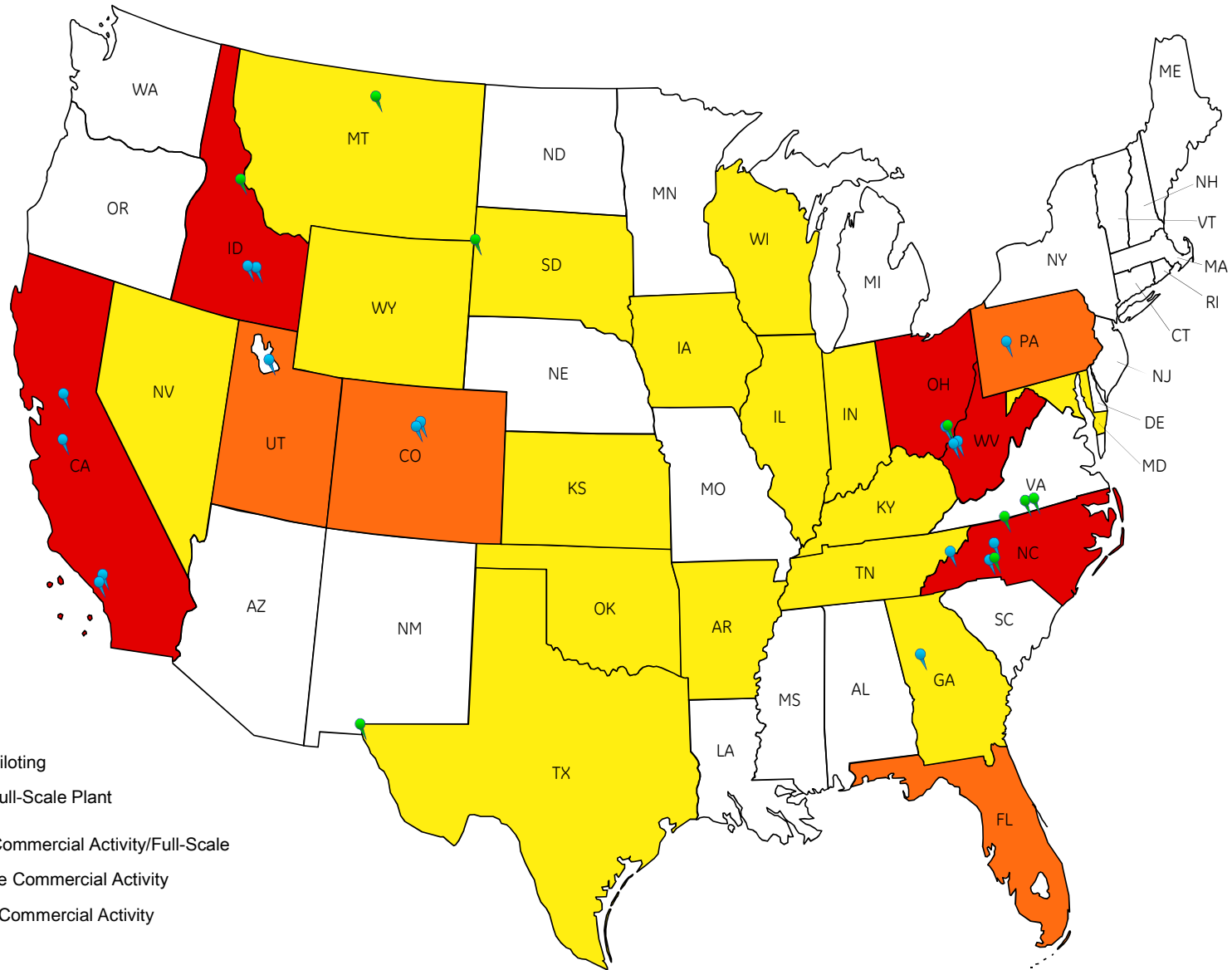
1 H																	2 He
3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
55 Cs	56 Ba	57 La	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
87 Fr	88 Ra	89 Ac	104 Unq	105 Unp	106 Unh	107 Uns	108 Uno	109 Une	110 Unn								






■ hydrogen ■ poor metals
 ■ alkali metals ■ nonmetals
 ■ alkali earth metals ■ noble gases
 ■ transition metals ■ rare earth metals

58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu
90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr

Selenium Usage





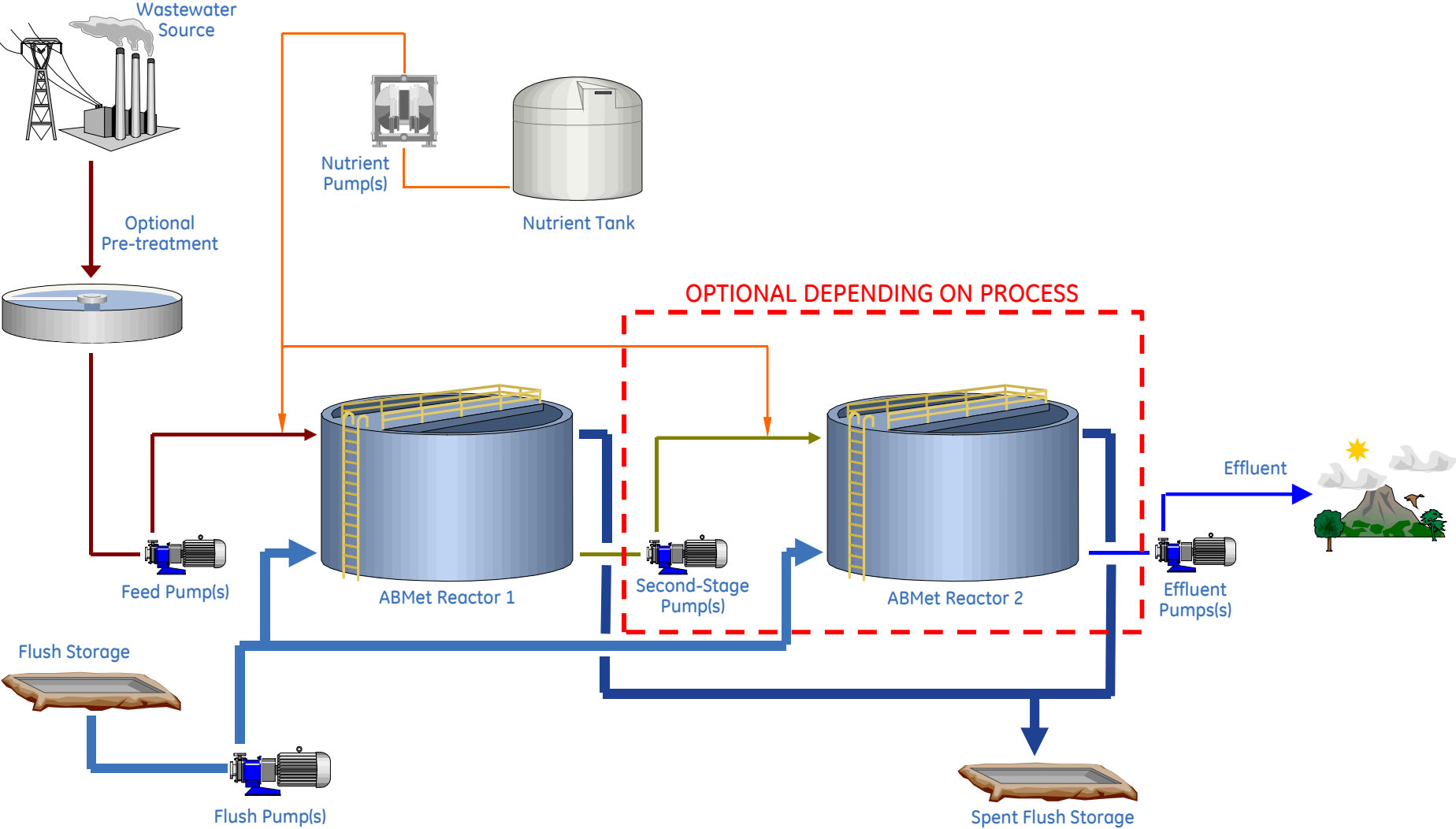
-  ABMet Piloting
-  ABMet Full-Scale Plant
-  Strong Commercial Activity/Full-Scale
-  Moderate Commercial Activity
-  Minimal Commercial Activity

■ Why biological treatment for Se?



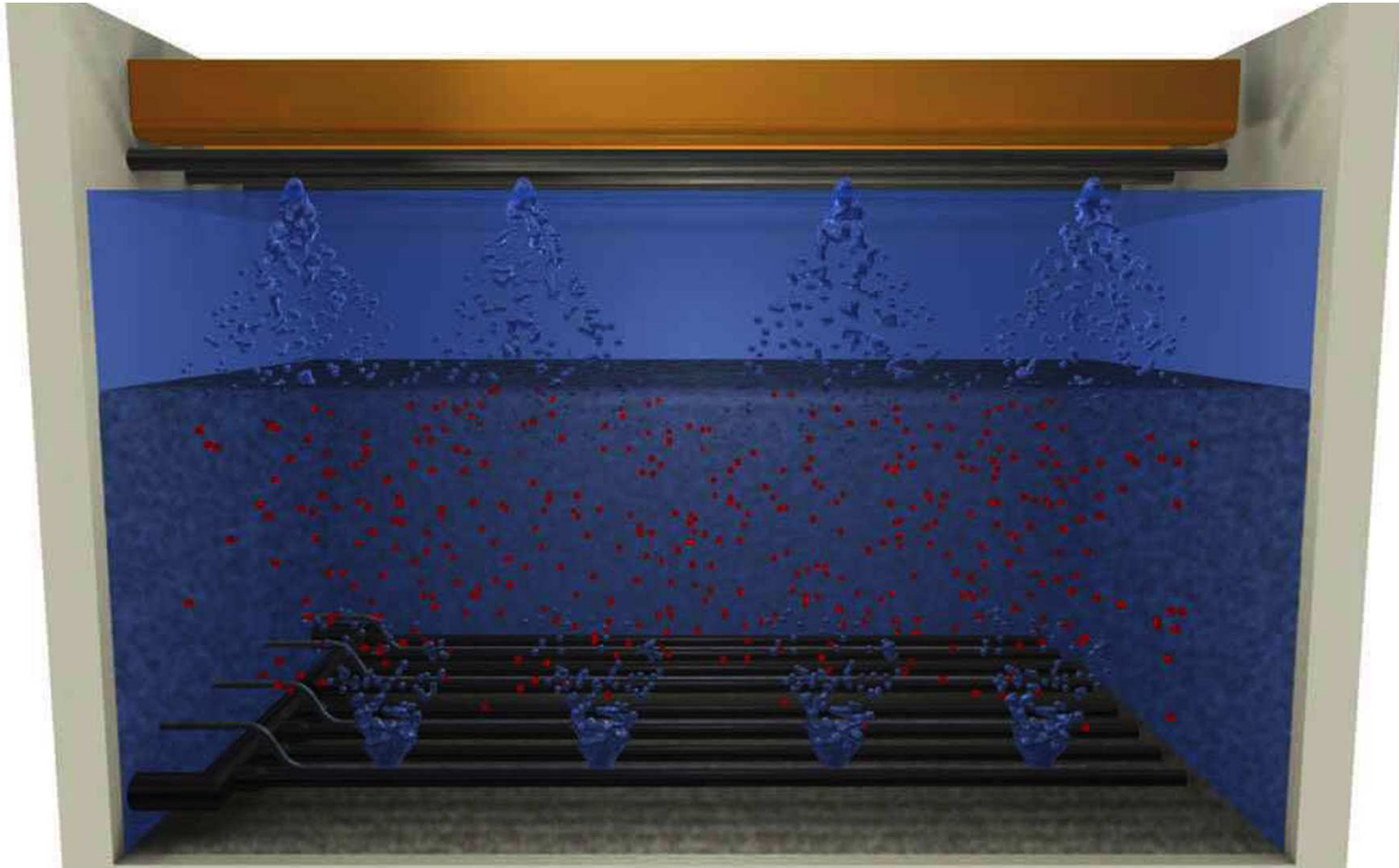
- Simple and efficient
- Removes both selenate and selenite
- Produces minimal sludge
- Low operating and maintenance costs
- Proven and reliable
- Guaranteed performance

ABMet flow diagram



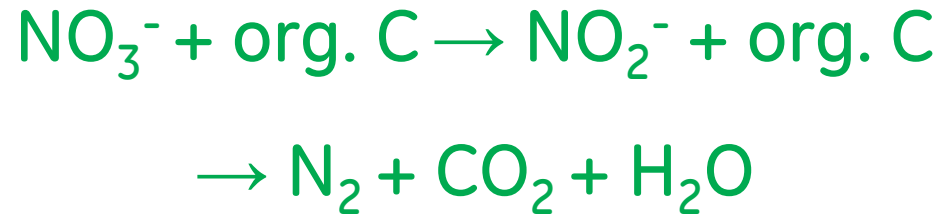
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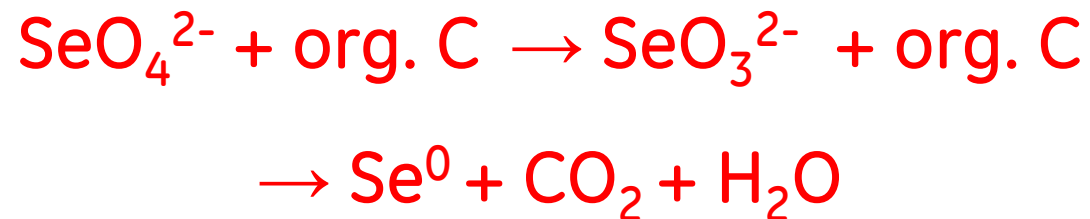


Biochemical reduction

Nitrates are converted to nitrogen gas



Bacteria reduce oxidized forms of selenium to elemental selenium

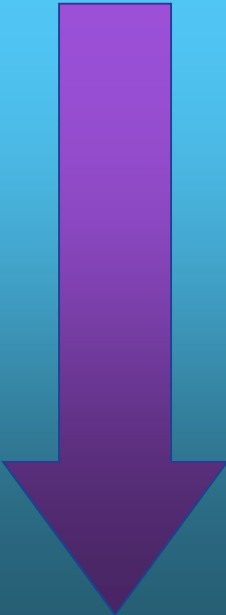


Dissolved metals are converted to metal sulfides and are retained within the system

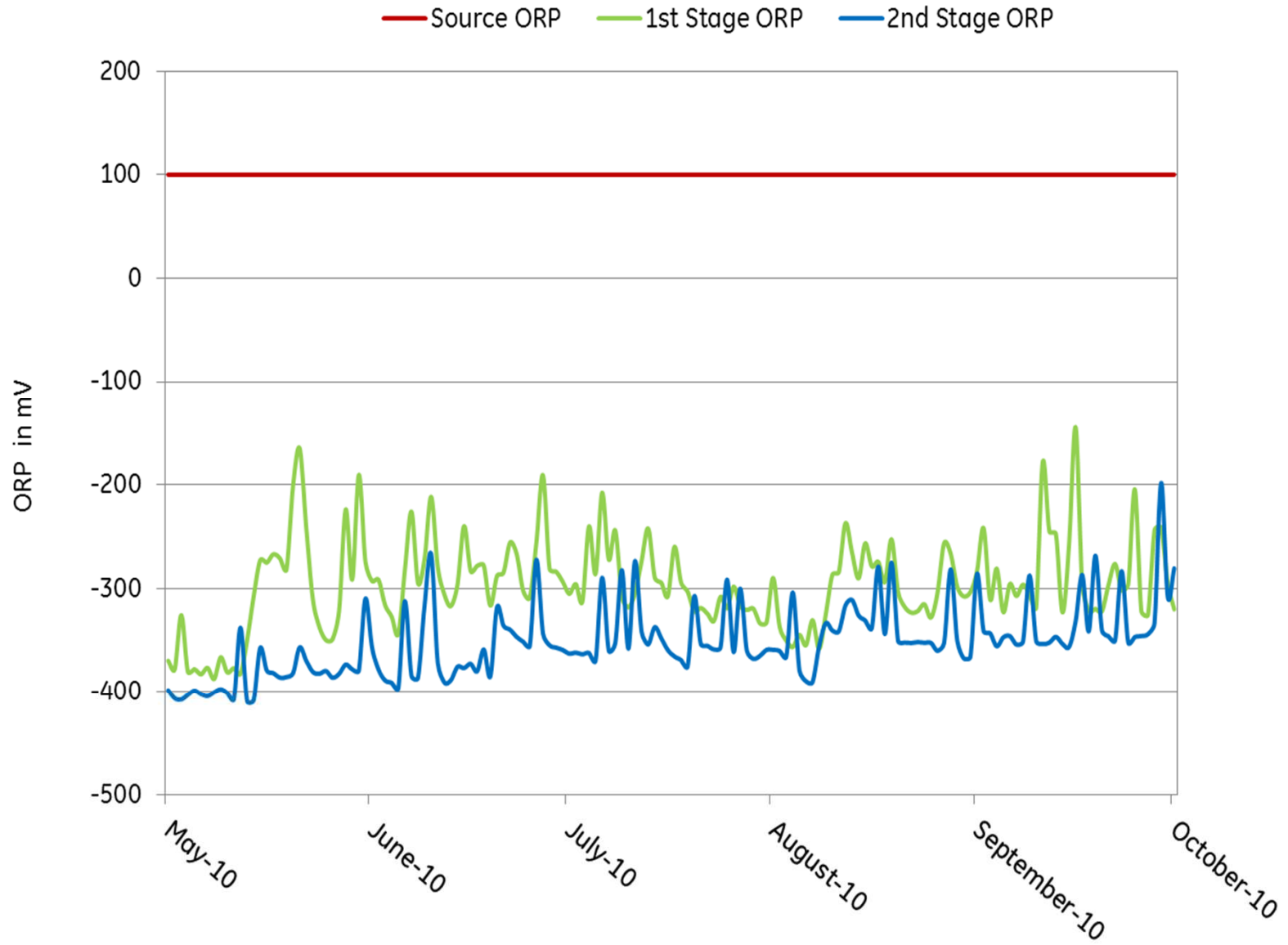


(where M= Metal)

ABMet: respiration and reduction

ABMet Bioreactor	Respiration: Final e ⁻ Acceptor	Approximate ORP
	Oxygen	>0 mV
	Nitrate	< 0 mV
	Nitrite	< -50 mV
	Selenate	< -100 mV
	Selenite	< -150 mV
	Sulfate	< -200 mV

Full-scale ORP Data





ABMet Selenium Reduction/Precipitation



1 μm



Mag = 15.00 K X

EHT = 15.00 kV

Signal A = SE2

Date :14 Jul 2010

WD = 13.2 mm

File Name = Pseud_Se_top_15k_06.tif

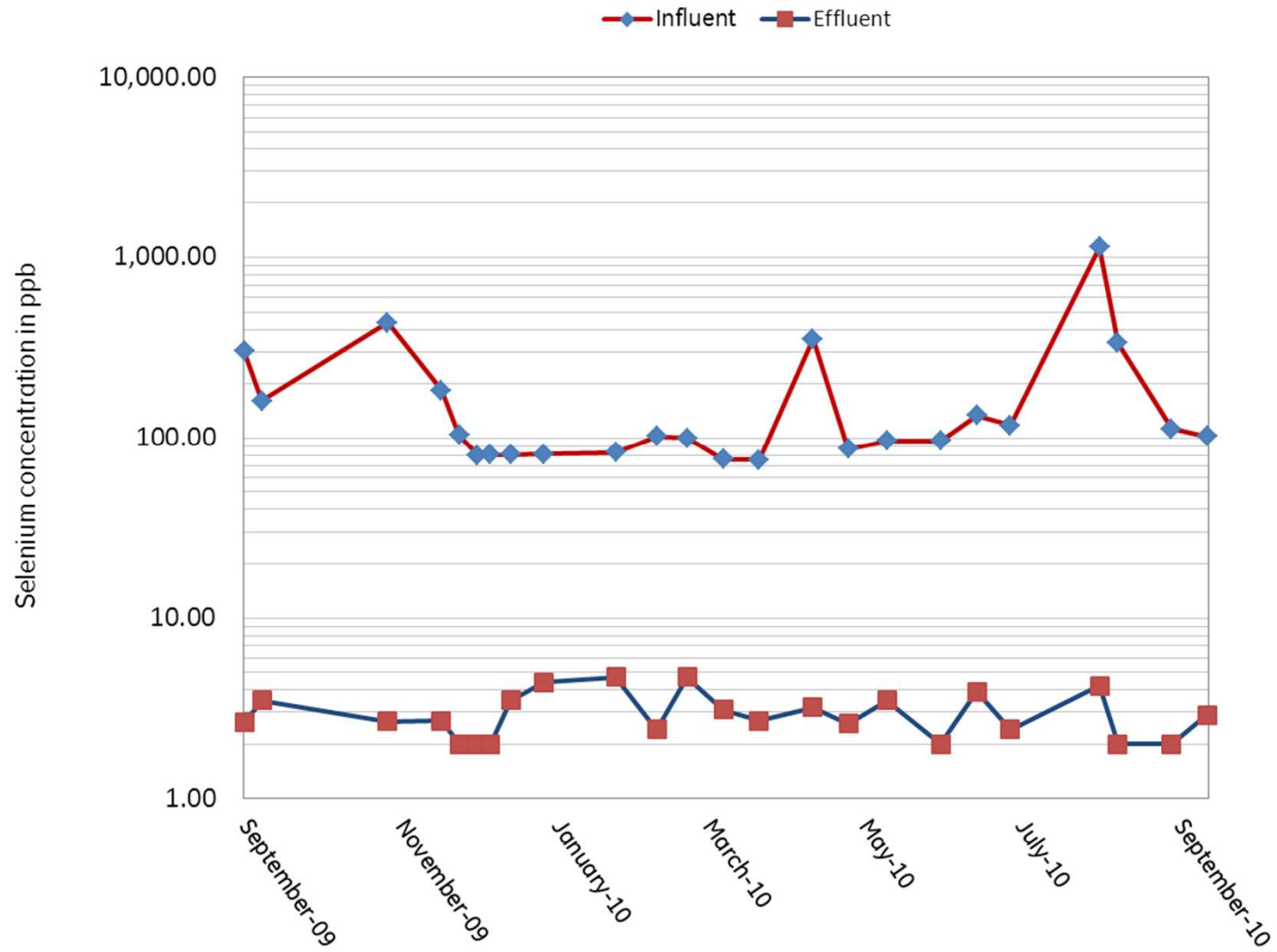
Denault

Width = 7.622 μm

Height = 5.717 μm

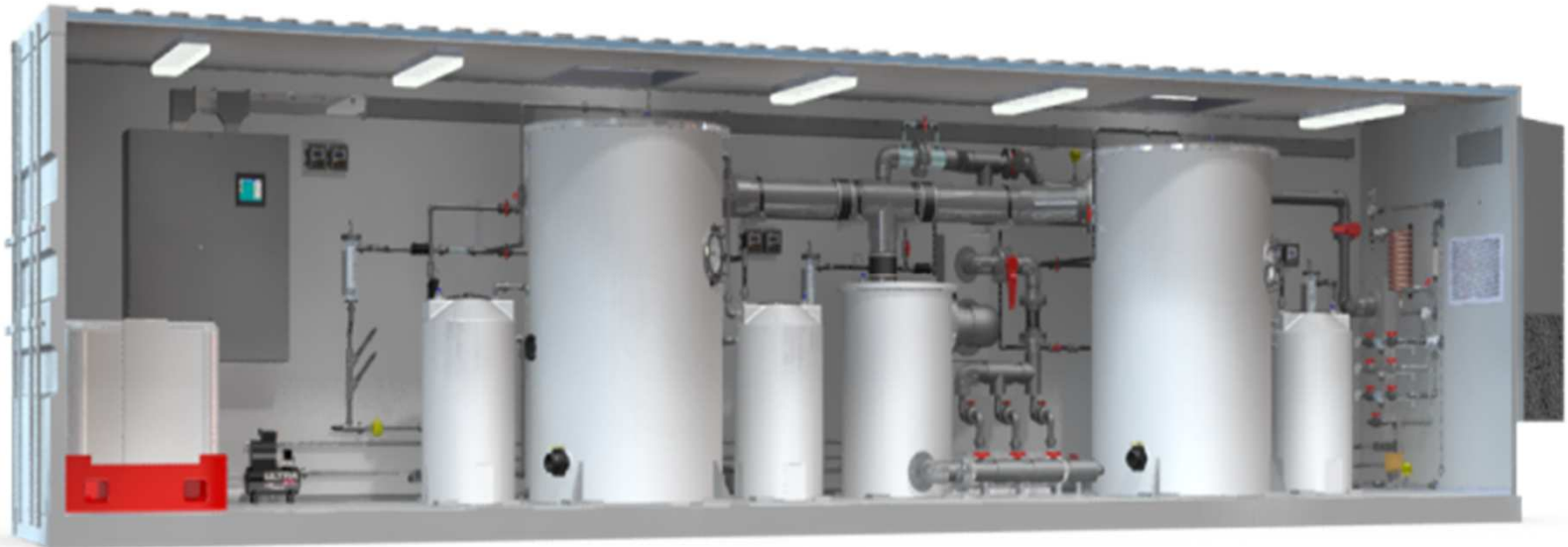
Stage at T = 0.0 °

Full-scale Selenium Removal



Design Considerations

- Water Chemistry
- Retention time (EBCT) – experienced based, pilot based
- Configuration – one or two stage
- Waste Disposal
- Secondary Limits
- Pre or Post-treatment

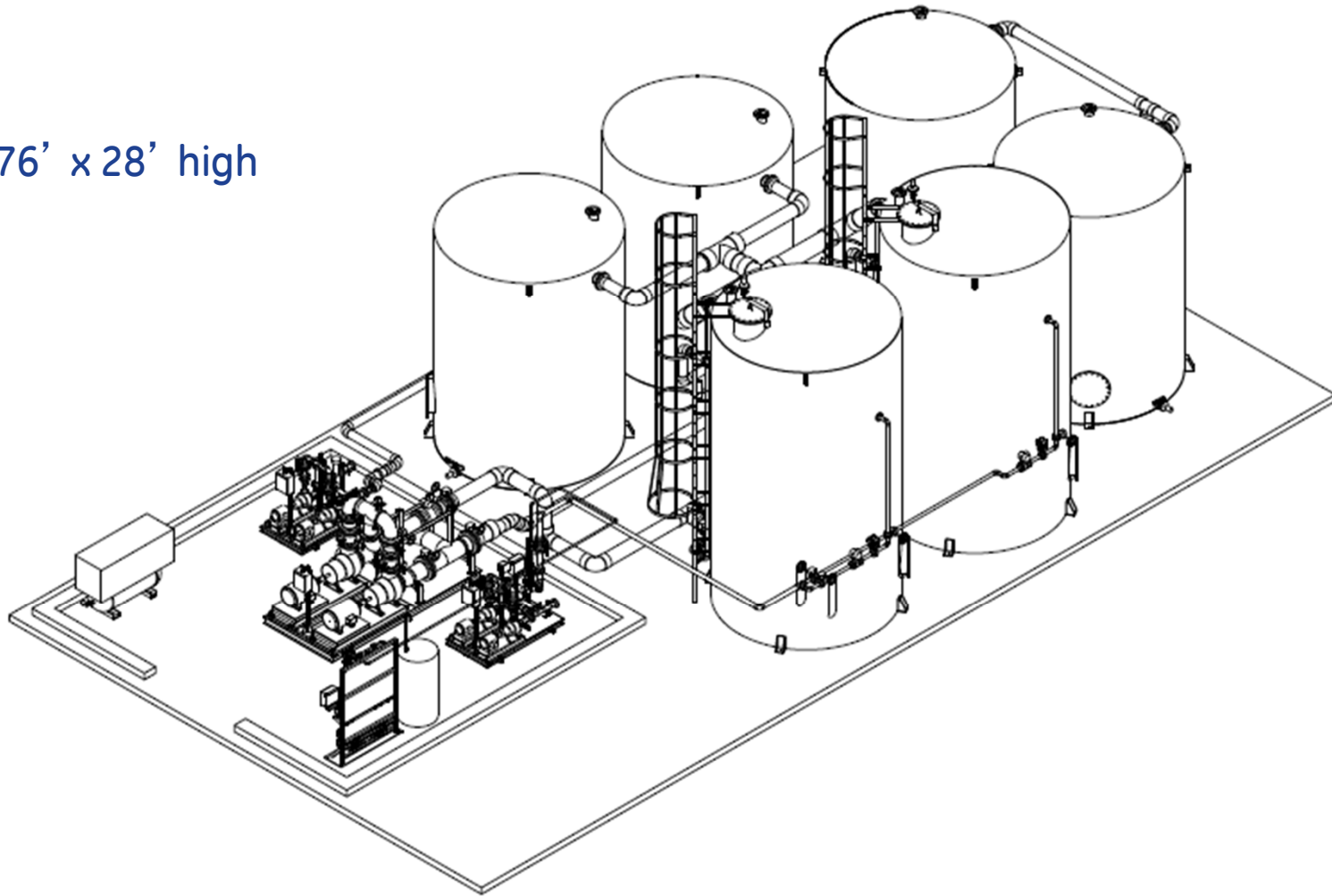






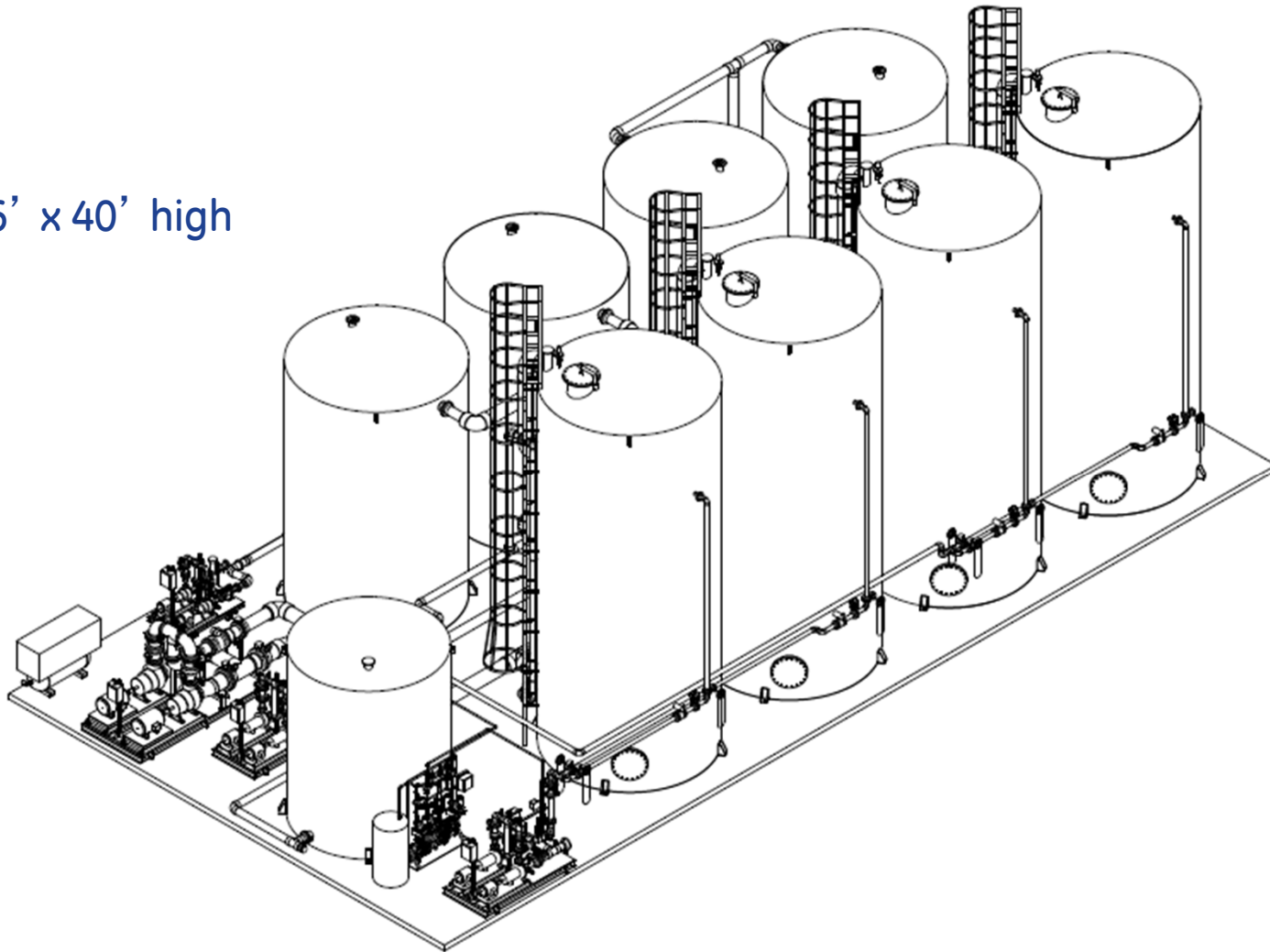
200 GPM (45 M³/h , 1-stage, 2-train, 4 h

42' x 76' x 28' high



400 GPM (96 M³/h) 2-stage, 2-train, 4 h

45' x 86' x 40' high



ABMet costs

Diverse Configurations

Power



- Complex, custom systems
- High-end components (corrosion)
- High redundancy
- High Se loading

Estimated installed cost:

- 1400 gpm (318 M³/h)- \$24MM

Operational cost:

- < \$200 K / Year

Mining



- Modular systems
- Robust, proven components
- Remote operation
- Low to moderate Se loading

Estimated installed cost:

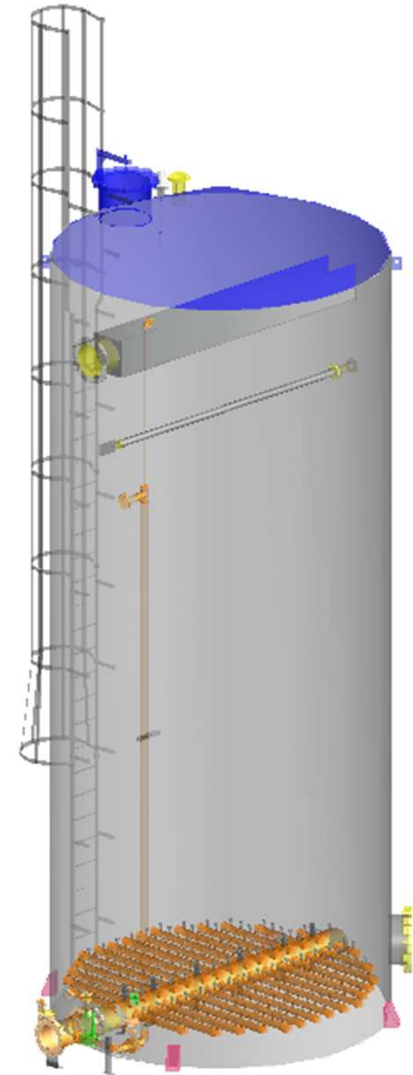
- 100 gpm (23 M³/h) = \$4MM
- 400 gpm (96 M³/h) = \$8MM

Operational cost:

- \$65K/ year (400 gpm)

What is next?

- Smaller
- Faster
- Lower Cost
- Enhanced performance



The background of the slide is a close-up photograph of numerous water droplets of various sizes scattered across a blue surface. The droplets are in sharp focus, showing highlights and shadows that give them a three-dimensional appearance. The overall color palette is a range of blues, from deep navy to lighter, sky-like blues.

Thank You!

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<http://www.gewater.com/ABMet.jsp>