

# Quinn Process Equipment Co.

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To whom it may concern:

Re: QPEC Experience in the Design and Manufacture of Mixer-Settlers

We are sending the following to introduce our company and relate our history and experience in the design and manufacture of QPEC Solvent Extraction Mixer-Settlers.

Quinn Process Equipment Company manufactures a broad range of equipment for pilot plant and commercial size mineral processing plants. You can visit our website at [www.quinnprocess.com](http://www.quinnprocess.com), where, under "Products and Services", are some photos of our mid size SX mixer-settlers.

The following is a brief description of Quinn Process Equipment Company's experience in the area of design and manufacture for mixer-settler solvent extraction units.

We at Quinn Process Equipment Company have specialized, for over 30 years, in the design and manufacture of process equipment for pilot plants and small commercial size plants in the minerals industry. Our equipment includes materials handling, crushing, grinding, classification, agitation, conditioning, flotation, filters, pumps, thickeners and mixer-settler solvent extraction equipment.

The majority of our equipment can be supplied in a broad range of materials of construction to meet the needs of the particular application. These include mild steel, many stainless steel alloys, a wide variety of rubber linings, urethane lined, many thermoplastics, fiberglass in numerous resins and other exotic alloys and materials such as titanium, inconel and monel materials.

We have extensive experience in the successful design and manufacture of a broad range of mixer-settlers. The following is a description of our history, installations, personnel of operating plants that you are free to contact (some of these plants are confidential and the client will probably be hesitant to discuss the exact process).

These units have always included the mixer and settler tank(s) and also the complete mixer mechanism(s).

**Quinn Process Equipment Company**  
**Partial List of Installations**

## QPEC Mixer-Settler Units

The following is a partial list of QPEC Mixer-Settler installations. Our installations, as indicated, cover a wide range of minerals such as copper, molybdenum, indium, germanium, gallium, boron, yttrium, uranium, vanadium, etc.

CLIENT	SITE LOCATION	APPLICATION
Noranda	Agnew Lake	Uranium
Freeport Chemical	Uncle Sam, LA	Uranium from phosphoric acid
Wyoming Minerals	Bingham Canyon, UT	Uranium from copper leach tails
Hecla Mining	Arizona	Copper from leach solution
Greenback Industries	Arizona	Copper from leach solution
United Chemical	Arizona	Copper from leach solution
Ranchers Exploration	Naturita, CO	Uranium-vanadium from leach tails
Brush Wellman	Utah	Uranium from leach solution
Bokum	New Mexico	2000 ton uranium mill
Anaconda	Arizona	Uranium from copper leach solution
AMOK, Ltd	Saskatchewan	Pilot plant for uranium ore
Kerr McGee	Idaho	Pilot plant uranium-vanadium from phosphoric acid
Mono Power	Idaho	Pilot plant uranium-vanadium from phosphoric acid
Energy Fuels	Blanding, UT	2500 tpd uranium-vanadium plant
Plateau Resources	Utah	800 tpd uranium-vanadium plant
AMAX	Iowa	Paratungstate plant
Earth Sciences Ext.	Calgary, Alberta	Uranium from phosphoric acid
Cerro Copper Prod.	Illinois	Copper from leach liquors
Dennison Mines, Ltd.	Canada	Yttrium recovery from uranium
Sociedad Chilena de Litio, Ltd.	Chile	Lithium plant- boron recovery
Hecla Mining	Utah	Copper, gallium, germanium recovery
Cominco, Ltd.	British Columbia	Indium recovery
P.T. Petrokujang	Indonesia	Uranium from phosphoric acid
CODELCO	Chile	Rhenium, molybdenum recovery
BHP-Utah Intl.	California	Copper recovery
East Penn Mfg.	Pennsylvania	Cleaning spent battery acid
Egypt	Egypt	Mineral pilot plant
COGNIS	California	Hazardous waste metal recovery
United Engineers	New York	Remove sulfates from stack residues
Proler Intl. / Western States Engineering	Arizona	Copper recovery from waste material
Placer Dome, Inc.	British Columbia	Copper pilot plant
Ivanhoe Myanmar/ KD Engineers	Burma	Copper pilot plant
Cabot Corp	Pennsylvania	30 stage SX for exotic metal recovery
BHP/Bateman Eng.	Zimbabwe	9 stage unit for Cobalt recovery
BHP Minerals	California	10 stage pilot unit for confidential plant
AMAX Metals	Louisiana	6 stage pilot unit for confidential plant
Copper Range Mining/ Davy International	Michigan	4 stage unit for Copper recovery
Phibrotech	Texas	2 stages replacement FRP units
American Microtrace	Nebraska	4 stages for proprietary process
BHP Minerals		4 stages for general application

Thai Copper Ind./		
Kvaerner Metals	Thailand	2 stages 316LSS for copper recovery
BHP Minerals		4 stages for general application
US Filter	California	9 stages for confidential process
Inco	Newfoundland	22 stages for a confidential process
Alkane Exploration	Australia	15 stages for confidential process
Premier Technologies	Idaho	20 stages 316LSS units for confidential process
Premier Technologies	Idaho	20 stages borosilicate glass units for confidential process

As can be seen from the above list, QPEC has furnished numerous mixer settlers to a wide range of new and repeat clients. Our units are in use throughout the world with numerous plants in Canada, Southeast Asia, the United States and Chile, to name a few.

Some operating personnel for you to contact for references are as follows:

--- Harold Roberts  
Dennison Mines (formerly International Uranium)  
Phone: (303) 628 7798

--- Bill Ahrens  
Consulting Engineer  
Phone: (520) 743 0663

--- Richard Leiby  
East Penn Manufacturing (Pennsylvania)  
Phone: (610) 682 6361

--- Randy Scheffel - Consultant- Myanmar Holdings  
Phone: (303) 525 2163

We have furnished units with settlers as large as 25' x 62' and 32' x 62' with mixers for Chevron's Pana Maria plant and Energy Fuels at Blanding, Utah. QPEC units have treated pH's in the 1.0 range and gpm flows from **100 ml/min. to 2000 gpm.**

Our pilot plant units are designed as package systems complete with all interstage piping, and provision for recycles as necessary, mounted on a common structural steel frame complete with electric drive motors in explosion proof construction with VFD speed controls shipped separately for customer installation.

All of the companies shown on the above list purchased the complete mixer-settler units from Quinn Process Equipment Company. **All systems started up quickly without complications or failures. They all performed to complete satisfaction without difficulty.**

**IMPORTANT: QPEC Mixer-Settlers utilize impellers in the mix tanks which are designed to both advance (pump) and mix the various feed streams (aqueous, organic and recycle) intimately as they enter the mixer eye. No interstage pumps are necessary, thereby simplifying the control and operation of the units. The only pumps necessary are the**

**external feed pumps for the aqueous and organic feeds to the system and their associated tanks, flowmeters and valves. Mixers can be furnished in simplex, duplex and even triplex configuration utilizing axial flow type auxiliary mixers.**

Units can be fabricated in a wide range of materials of construction to suit the application. All QPEC mixer-settlers are designed to have the same relative liquid level in both the mixer and settler to allow for simple shut-down and start-up with no need for surge tanks to accept back flow. Larger units will require a pad or some other form of support under the settler to bring the settler liquid height up even with the liquid height in the mixer tank.

We require the following information in order to submit our recommendations for a solvent extraction mixer-settler system. Generally a flow sheet and test work have been done to generate this data.

- 1) Circuits involved (i.e.: extraction, wash, strip, etc.)
- 2) Number of stages in each circuit.
- 3) Flowrates for organic, aqueous and recycles (state whether organic or aqueous) for each circuit. Also, specific gravity for each.
- 4) Mixer retention time required for each circuit.
- 5) Settler area requirements, normally stated in gallons per minute per square foot or cubic meters per square meter per hour.
- 6) Nature and concentration of the various streams involved, or, if available, the desired materials of construction.
- 7) Electrical requirements, both voltage and enclosures for the motors.
- 8) Any special requirements for the site, such as venting, size limitations (doorways etc.), indoor or outdoor installation and seismic or loading for settler covers (if required).

If you do not have a flow sheet and the above sizing data, please advise and, if assistance is needed for generation of this information, we are familiar with some consultants that would be willing to assist.

We sincerely appreciate the opportunity to submit our recommendations for this and any future projects in which you may be involved.

Regards,

Richard (Rick) Quinn  
President