



Galileo™ Chemical Distribution Technology

MicroTech Systems, Inc.

Galileo is a patented "gravity to feed" and "pressure to deliver" chemical distribution technology. There are no pumps or vacuum; just gravity and pressure.

Pumps within chemical distribution systems are one contributors to the cost of ownership, to the degradation of a safe manufacturing environment and a possible contributor to the degradation of device yield. Pumps need to be refurbished and then recommissioned; every six months. They also leak and can cause the degradation of the quality and cleanliness of chemicals.

Vacuum-based systems stress the company's exhaust systems and alter the composition of the liquid being distributed.

By being able to exclude both pumps and vacuum, Galileo continuously feeds and distributes chemicals without the degradation of the quality as received from the chemical manufacturer.

Galileo is a chemical distribution technology free of pumps and vacuum. **See Figure 1.** Through a patented process which includes gravity as its primary driving force, solvents, acids, bases, mixtures or CMP slurries, can be moved to their point of distribution without any other aid. Galileo uses a siphon to initiate gravity-feed into underlying pressure vessels. **See Figure 2.** The initiation takes about ten seconds. Then, and by the pull of gravity, chemicals feed from the drum or tote to the two pressure vessels below. As one pressure vessel dispenses the second pressure vessel fills by the pull of gravity.

Galileo maintains the purity and performance of the chemicals it delivers. There are no moving parts from pumps that eventually break down to shed particles and there are no mechanisms which physically shear

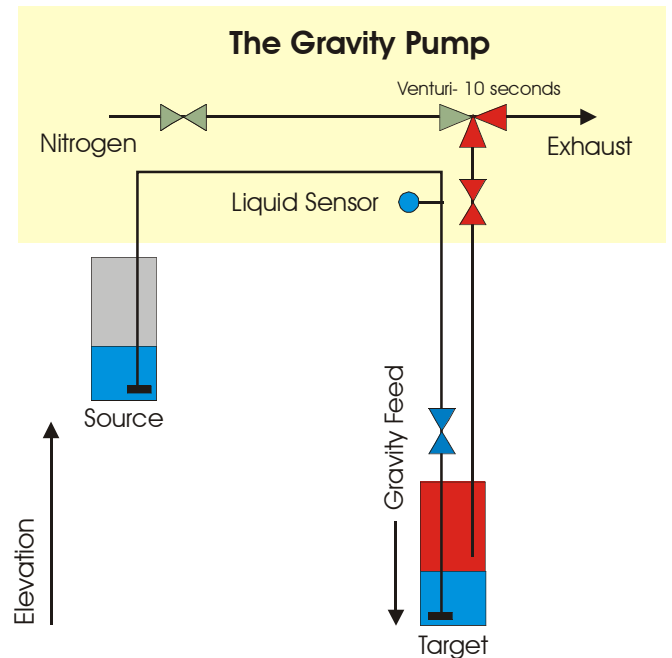


Figure 1

Galileo gravity feed technology.

the chemicals or add other physical stress to the chemicals. Essentially, and until they reach their point of use, chemicals fed by gravity are maintained at the state they entered the system.

Galileo is modular in construction and design. It can be offered with both single and dual-drum/tote capability, auto-switchover and recirculation (for slurries).

Drum-based recirculated Galileo systems can operate uninterrupted up to about 3.5 gallons per minute with no surges in flow rate. Under similar conditions, tote-based systems operate at higher flow rates.

Theory of Operation

A filled drum or tote is placed above a double-containment vessel which houses the pressurizable chemical distribution vessels. **See Figure 2.** A line is attached to a drum dispense head which is also attached to a siphoning device. For recirculation-based systems, a second return drum dispense head is attached. First, a siphon is generated (a temporary pull on the bung for 10 seconds) until chemical is drawn out of the drum. Then, the liquid feeds by gravity to the underlying pressure vessels and the pressurized vessels dispense outward to the points of use. While incorporating a recirculation loop, the recirculated chemical is returned to the drum or tote.

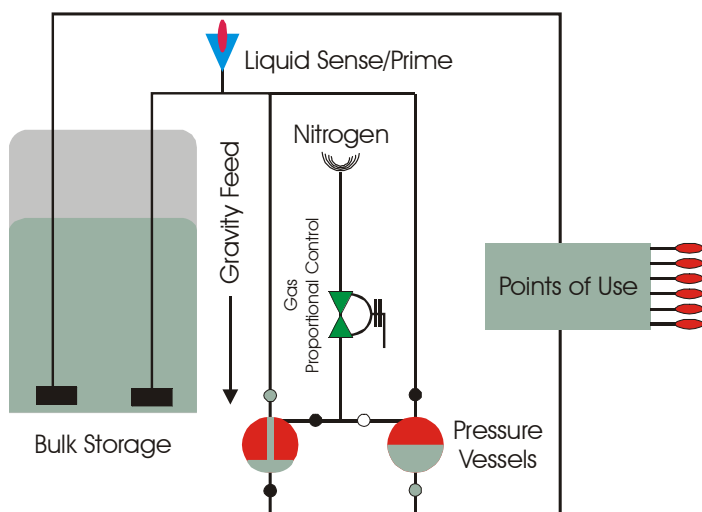


Figure 2

Gravity to feed and pressure to deliver.

When feeding by gravity from the first pressure vessel to the second, the outward flow to the points of use remains smooth; smooth without surges.

Design and Development Goal

Galileo was developed to address the following process and engineering challenges faced with sub-65nm technology.

- . . . The need for higher purity methods of chemical delivery.
- . . . Chemical delivery methods which maintain the quality of performance materials being delivered.
- . . . The need for more robust, consistent, higher reliability, chemical delivery methods.

Galileo was designed to meet the most stringent requirements for high-purity processing and chemical delivery. Because there are no pumps, we were able to simplify the distribution mass flow. There are fewer moving parts which should lead to a more certain ability to maintain the quality of the chemicals being delivered. Being pumpless offers an unprecedented opportunity to distribute sheer and shock-sensitive chemicals without altering the properties of the chemical such as CMP slurries.

Chemical distribution systems are the source of the fluids which feed the veins of a device manufacturing process. If a chemical distribution systems fails, a

measurable portion of a plant's manufacturing operation shuts down. We worked diligently to remove components from the system which tend to fail or have PM's which happen at frequencies greater than other manufacturing equipment relying on these systems. Furthermore, we worked through an internally established expectation that a company's chemical distribution technology be more robust and reliable than the systems which make use of the technology. Galileo is an example of a comprehensive design conceived by process engineers who rely heavily on the consistent, transparent and robust performance of this technology.

The Improvement Chemical Quality

CMP Slurries are sensitive to shear forces from mixing and from pumps. When subjected to these types of forces, the particle size distribution broadens through the agglomeration of the particles into larger particles. With the Galileo gravity-feed technology, there are no mixers and pumps. **Figure 3** shows how

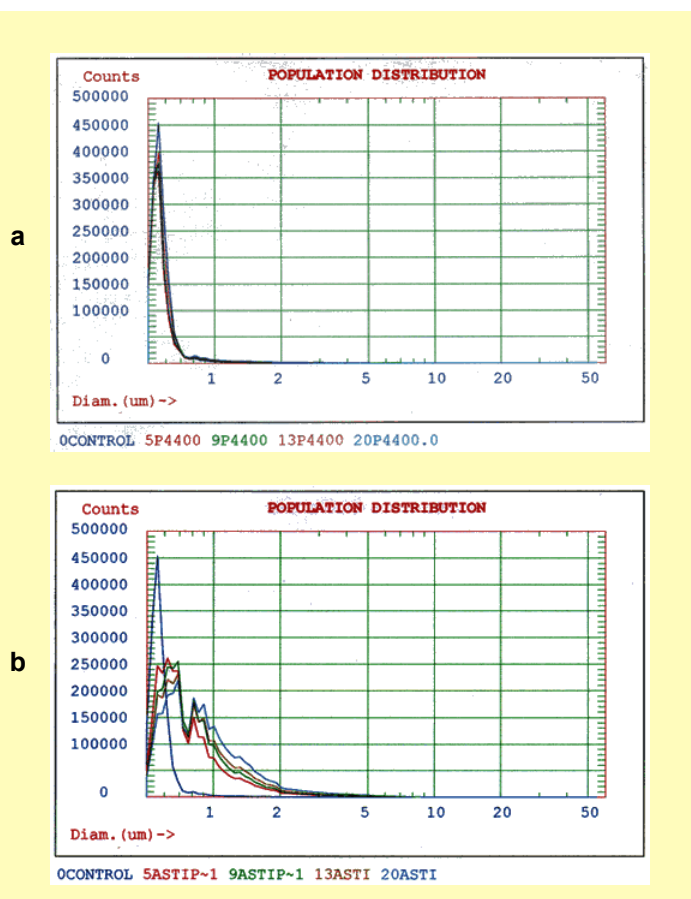


Figure 3

Galileo gravity-feed (a) versus pump-feed (b) chemical distribution technology. Variance in slurry particle size distribution over 5, 9, 13 and 20 days.

a silica CMP slurry varies with time using the gravity-feed chemical distribution technology versus pump-based slurry distribution technology.

Maintaining Chemical Performance (CMP Slurries)

There are cases where evaporation plays a substantial role in the performance of some chemicals such as CMP slurries. The Galileo technology compensates for this loss with an in-line humidifier.

Verifying Chemical Quality

We offer additional in-line detection and monitoring systems such as pH meters, concentration-monitors, densitometers and particle monitors.

Ease of Maintenance

Galileo is set up for the highest rigors of production and the easiest and safest means of handling unscheduled and scheduled maintenance. The Galileo modular design is accessible from the front. The entire plumbing manifold and recirculation-loop is accessible remotely through the maintenance mode of our touch-screen computer controlled system. Remote drum/tote and recirculation system purging, rinsing and cleaning is achievable from here as well.

Flow Performance

Galileo can be set up with or without a recirculation loop. Single drum systems without recirculation can push chemicals out to points of use at a rate of 6 gallons per minute. Systems with continuous recirculation can supply 3.5 gallons per minute to the point of use.

System Options

The following options are available based on the chemical being distributed.

- ... Stainless steel, Polypropylene, PTFE or PFA construction*
- ... Densitometers, pH meters, concentration monitors, conductivity, particle sizing monitors*
- ... Digital flow meters*

- ... Recirculation loop*
- ... Auto drum or tote switch-over*
- ... Sample/assay box*
- ... External day tank(s)*
- ... Mix-blend system (remote and point of use)*

System Performance

- ... Single and dual-drum (with auto-switchover) based systems.*
- ... Solvents, acids, bases, slurries and mixtures. 3.5 gallons (13.5 liters) per minute sustainable over 300-foot (100 m) recirculation flow loop.*
- ... 6.0 gallons (24 liters) per minute delivery out to 300-feet (100 m) without recirculation at 20 psig.*
- ... 7.0 gallons static capacity for drum-based system.*
- ... 110% containment*
- ... Touch-screen interactive computer control of single and multiple systems.*
- ... Explosion-proof and Title 80 explosion proof enclosures for solvent distribution systems.*
- ... 1-3 CFM Nitrogen.*
- ... 120 VAC*
- ... D.I water*
- ... 36"W X 42"D X 76"H footprint (double the width for a dual-drum system).*
- ... Single and dual-tote (with auto switchover) systems available as well.*

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