How to Build a Low-Cost but Effective Keg Washing System

In real-life, Thrifty's alter ego is the Head Brewer at the Pearl Street Grill & Brewery, a very busy and successful brewpub in Buffalo, NY. As a professional brewer working in a small craft brewery. I have occasionally found myself in search of commercial equipment to make the job easier, increase output, or to facilitate opening new markets. Unfortunately, what I usually find is equipment that is either too elaborate for my needs, too expensive, or, you guessed it, both. It is on such occasions that I am truly thankful that I am able to transform at will from a humble craftsman to "TA-DAAH!" the Thrifty Gadgeteer! Yes, Thrifty has saved the day, and a whole lotta bucks as well, on more than one occasion, and I thought it would be fitting to share some of his exploits with my fellow craft brewers. You home brewers are welcome to tag along if you like, especially if you are among those who have the typical delusions about one day turning your hobby into a vocation – be careful what you wish for, because you just might get it – in which case this episode of the Thrifty Gadgeteer might come in very handy indeed. This project is aimed at brewpubs and very small start-up breweries where low-volume external distribution of draft beer is part of the business plan, but money and space are hard to come by and even harder to part with. Now, if you are going to distribute draft beer, you'll have to put your beer in kegs. And before you can put your beer in the kegs, you will, of course, have to clean the kegs. And in order to clean the kegs, you'll need a keg washing machine. A very expensive automated keg washing machine that requires dedicated power, water supply and drainage, and space. Or not. What if I told you that it is relatively easy to build a manually controlled keg washing "system" that can perform all of the functions that the automated machine does, and that you can do it for less than \$500 as compared to the \$10,000 it will cost you for the commercial model with all the bells and whistles you don't really need anyway? If I've caught your interest, then read on.

In a low-volume situation where you are processing, say, 50 or so kegs a week, you really don't need that expensive automated keg washer because you aren't processing enough kegs to make the thing pay for itself. What you need is something that will do all of the things necessary to properly clean your kegs in small batches of around ten or twelve in a session. So, the first thing you need to do is look at the functions that are performed by a keg washing machine, which are:

- 1. Purge beer residue from the keg.
 - A. Blow-out any beer remaining in the keg to waste drain.
 - B. Rinse-out the keg and blow-out the rinse water to waste drain.
- 2. Turbo-clean the inside of the keg with a recommended cleaning agent, usually an acid specially formulated to work in a CO2 atmosphere.
- 3. Purge cleaning agent from the keg and reclaim cleaning agent for reuse.
- 4. Rinse cleaning agent residue from keg to waste drain.
- 5. Purge water & air from keg and pressurize keg with CO2.

Now, an automated keg washing machine is just like your laundry machine or dishwashing machine at home – it has a timing and switching mechanism that opens and closes valves and turns pumps on and off in a carefully choreographed sequence that performs all of the necessary functions in the right order for the right amount of time. The contraption I'm

proposing can perform all of the same functions, but you'll have to control it manually. I'm betting that if you are smart enough and have the dexterity it takes to successfully craft-brew beer professionally, you probably have the ability to remember the proper sequence and to open and close valves and throw switches by hand. If not, then your ability to build this project is questionable at best, and you might want to consider another line of work.

if you are still with me you must be one of the ones with the requisite skills to continue, so I will. Next, you need to consider that the commercial keg washing machine is expensive not just because it does all the thinking and controlling for you, but also because it is fully selfcontained and has its own dedicated pump. You should already have a very adequate portable pump that you use to clean your tanks with, so why buy another? Let's just use that same pump to power our homemade keg washing system. Another thing almost every brewery has laying around, or can get without much trouble or expense, is a bad keg – you know, the one with the big dent in it, or with the mangled valve flange, or the hole where the weld seam has begun to split. Yeah, that one! What good is it to you the way it is? It really can't be fixed so that it would be safe to use, but you just can't bear to part with it, can you? Well, now you can keep it and make it useful again by pressing it into service as the reservoir for the keg-cleaning agent. The other things you already have that we will borrow when our system is actually in use are a couple of short lengths of beer transfer hose (the ones you usually use with your pump to clean your tanks with will do nicely), miscellaneous sanitary fittings (clamps, elbows, etc.) as needed to make for smooth and easy connections and a standard lever-type keg tapping connector with tail pieces for 1/2" hose.

The rest of the stuff you will need, and will probably have to buy, is as follows:

- (2) 1/4" FNPT Ball Valve, Stainless Steel (304 or 316)
- (5) 3/4" FNPT Ball Valve, Stainless Steel (304 or 316)
- (2) 1/4" MNPT X Male Air Coupling, Brass
- (4) 3/4" FNPT Tee, Stainless Steel (304 or 316)
- (2) 3/4" MNPT X 1/4" FNPT Reducer Bushing, Stainless Steel (304 or 316)
- (2) 1/4" NPT Close Nipple, Stainless Steel (304 or 316)
- (10) 3/4" NPT X 1-1/2" Nipple, Stainless Steel (304 or 316)
- (4) Split-Ring Pipe Hanger Bracket for 3/4" Pipe
- (1) One foot piece of 3/8" Threaded Rod
- (4) 3/8" ID Flat Washers
- (4) 3/8" ID Lock Washers
- (4) 3/8" Hex Nuts
- (5) Adapter, 3/4"MNPT X 5/8" Hose Barb, Stainless Steel (304 or 316) or Brass
- (3) 3/4" FNPT Half Coupling, Stainless Steel (304 or 316)
- (1) 3/4" FNPT 90 degree Elbow, Stainless Steel (304 or 316)
- (3) 1-1/2" Sanitary Cap, Stainless Steel (304 or 316)
- (1) 3/4" NPT X 8" Nipple, Stainless Steel (304 or 316)
- (1) 50 foot coil of 5/8" ID X 7/8" OD Braided Clear Vinyl Hose
- (6) Hose Clamps for 5/8" Hose
- (1) 3 foot square piece of 5/8" or 3/4" Marine Grade Plywood, painted with several coats of a durable waterproof coating such as Epoxy or Marine paint.
- (1) 2" X 6" X 8" long construction lumber, painted with several coats of a durable waterproof coating such as Epoxy or Marine paint.
- (1) Roll of Teflon Tape

You will also need the services of someone who knows how to cut and weld stainless steel. If that someone is you, then you have a rare talent and a distinct advantage over mere mortals. Otherwise, you may be able to barter some of your fine product in exchange for said services, or, as a last resort, you could even pay someone to do it. I DID SAY AS A LAST RESORT!!! You'll still be way ahead vs buying a keg washer.

Construction is divided into three sections – the Cleaning Agent Reservoir, the Feed & Discharge Manifolds, mounting the Manifolds and installing the Hoses. We'll begin the project by converting the damaged keg into a Cleaning Agent Reservoir. Do not assume that the keg is not pressurized just because it is damaged. Unless it has a hole in it that you can easily see, always assume it is under pressure and your first step should be to depressurize the keg by installing and actuating a keg connector with a blow-off hose attached to the liquid (top) port on the connector. Once this is done you can safely turn the keg over to your welder and have him/her cut the top out of the keg, leaving the chine (the part with the handles) attached. Also have the welder remove the chine material over one of the handle-holes, leaving a gap where the handle was. All cut edges should be ground smooth so there are no irregularities, burrs, or sharp edges.

Assemble one 3/4" NPT X 1-1/2" Nipple to one leg of the 3/4" FNPT X 90 degree Elbow, wrench tight. Assemble the 3/4" NPT X 8" Nipple to the other leg of the 3/4" FNPT X 90 degree Elbow, wrench tight. Next, have the welder burn a hole in the side of the keg, just above the weld seam joining the bottom chine to the body of the keg, and centered on the cutout handle, to accept the 3/4" NPT X 8" Nipple. The vertical position of the hole should be measured to allow a 1/2" to 3/4" gap between the end of the 1-1/2" Nipple on the Nipple & Elbow assembly and the bottom of the keg when the assembly is mounted inside the keg, insert the free end of the 3/4" NPT X 8" Nipple through the hole in the side of the keg and align it so that the free end of the 3/4" NPT X 1-1/2" Nipple is pointing downward into the center depression at the bottom of the keg, with a 1/2" to 3/4" gap between the end of the semicline of the Nipple and the bottom of the keg. Weld the Nipple & Elbow assembly in place.

Next, burn or drill a 3/4" diameter hole through the center of each of the 1-1/2" Sanitary Caps, then weld a 3/4" FNPT Half Coupling to the outside (the beveled side, not the side with the circular groove) of each Cap. Make sure the Coupling is aligned exactly with the hole through the Cap. These assemblies are Adapters to allow sanitary (Tri-Clamp) connections. NOTE: You may want to substitute a Quick-Connect Fitting for one of the Adapters if your hot water supply is not set-up with sanitary connections. This will eliminate the need for one Sanitary Cap and one Half Coupling.

After the welds have cooled, assemble one of the 3/4" FNPT Ball Valves to the free end of the 3/4" NPT X 8" Nipple using Teflon Tape and wrench tight. Make sure the valve is positioned so that the valve handle points away from the keg when the valve is open. Assemble one 3/4" X 1-1/2" Nipple and one Sanitary Adapter assembly to the open end of the 3/4" FNPT Ball Valve using Teflon Tape and wrench tight. This completes the Reservoir.

Assemble the Manifolds next (see Manifold Assembly Diagram) - use Teflon Tape and wrench tight all connections. When installing the valves, choose orientations that will allow the valve handles to swing through the full 90 degree Open-Close arc without any interference. When the manifolds have been assembled, they can be mounted to the Plywood Board. For the Feed Manifold, I found it necessary to make a Riser out of a 2" X 6" X 8" long piece of construction lumber to provide clearance for the Sanitary Clamps between the Plywood Board and the Sanitary Adapters. First, determine and mark the position on the Plywood Board where you want to mount the Feed Manifold, then clamp the Split-Ring Pipe Hanger Brackets to the Manifold as shown on the Manifold Assembly Diagram. Cut two 3-1/2" long pieces of

3/8" Threaded Rod and thread them into the threaded holes in the Hanger Brackets. Position the Manifold on the Plywood Board with the free ends of the Threaded Rods touching the Board, then mark the positions of the Rods on the Board. Set the manifold aside and drill a 3/8" hole through the Board at each Rod position. Place the Riser on top of the holes with the holes approximately centered on the width of the Riser and equidistant from each end of the Riser, clamp or otherwise secure in place, then drill through the holes in the Board, into and through the Riser. Insert the free ends of the Rods through the holes, then secure the Manifold in place on the Board using one Flat Washer, one Lock Washer, and one Hex Nut on each Rod. Using a permanent black marker, mark the valves on the Feed Manifold as follows – mark the LEFT 1/4" valve "CO2", mark the RIGHT 1/4" valve "AIR", mark the LEFT 3/4" valve "WATER", and mark the RIGHT 3/4" valve "ACID".

The Discharge Manifold can be mounted directly to the Plywood Board. Follow the same procedure as for the Feed Manifold, except the steps relating to the Riser, and cut the remaining Threaded Rod into two 2-1/2" pieces (trim-off any excess after the manifold is mounted). Once the Manifolds have been mounted, you can cut the 5/8" ID X 7/8" OD Braided Clear Vinyl Hose into (3) 12 foot long pieces (save the remaining 14 foot piece for later). Attach one of the hoses to the Hose Barb on the Feed Manifold and secure in place with a Hose Clamp, then use a permanent black marker to mark the hose "FEED LINE". Attach one of the hoses to the Hose Barb on the CENTER leg (the one without a valve) of the Discharge Manifold and secure in place with a Hose Clamp, then use a permanent black marker to mark the hose "DISCHARGE LINE". Attach the last hose to the Hose Barb on the RIGHT leg) of the Discharge Manifold and secure in place with a Hose Clamp, then use a permanent black marker to mark the hose "RETURN LINE". Also mark the valves on the Discharge Manifold as follows – mark the LEFT valve "DRAIN", and Mark the RIGHT valve "RETURN". Ask your welder for a piece of 3/32" to 1/8" stainless steel welding rod (uncoated), about 6" long and use it to fashion an "S" hook. Make a small hole in the free end of the RETURN LINE, about 1/2" from the end, and hook the "S" hook into the hole.

Get the Keg Tapping Connector and remove the tail pieces and the check valves, then reinstall the tail pieces using new rubber washers. Attach the free end of the FEED LINE to the tail piece on the TOP of the Keg Connector and secure in place with a Hose Clamp (make sure the clamp is very tight because you are attaching 5/8"ID hose to a 1/2" tail piece). Attach the free end of the DISCHARGE LINE to the tail piece on the SIDE of the Keg Connector and secure in place with a Hose Clamp, again making sure the clamp is very tight. Finally, attach the remaining 14' piece of hose to the Hose Barb on the "DRAIN" valve on the DISCHARGE MANIFOLD and secure in place with a Hose Clamp, then use a permanent black marker to mark the hose "DRAIN LINE".

It's time to do a trial set-up with a keg to make sure everything goes together smoothly. First, place the Reservoir and Manifold Board in the area where you will be doing your keg cleaning. NOTE: I have not specified any particular method for propping or mounting the Manifold Board because it will be different in every brewery depending on your layout. With a little ingenuity, you could probably mount everything on a cart for easy portability and storage. Make sure all valves on the Manifold Board are CLOSED. Feed the free end of the DRAIN LINE into or near a floor drain – you may need to weigh it down to keep it from jumping around during discharge. Feed the free end of the RETURN LINE through the intact handle hole on the Reservoir and down into the bottom of the Reservoir. Use the "S" hook to secure the RETURN LINE to the pipe in the bottom of the Reservoir. Now connect the Keg Connector to the keg and flip the keg over so that it is standing upside-down on top of the Reservoir, and the FEED and DISCHARGE LINES draped through the gap in the chine on the Reservoir. Make sure the

Lines are not kinked. It may take some practice to achieve the proper positioning in one smooth "flip & place" motion, but I assure you it can be done. This is the starting position for each keg cleaning cycle. Reverse the motion to dismount the keg after cleaning. Once you have mastered keg positioning, you can set-up the rest of the connections for a test-run. Attach the Pump Inlet Port to the Sanitary Adapter on the Reservoir, either directly (the best way, if possible) or using a short length of brewery hose. Attach the Pump Discharge Port to the ACID valve on the FEED MANIFOLD using a short length of brewery hose. Connect your Hot Water Supply to the WATER valve on the FEED MANIFOLD. Connect your CO2 line and your Compressed AIR line to the corresponding valves on the FEED MANIFOLD. Both AIR and CO2 should be set to about 20-25 PSI. OPEN the valve on the FEED MANIFOLD and fill the reservoir about 2/3 full (10 gallons) with hot water, then CLOSE the WATER valve. OPEN the ACID valve for a few seconds, then CLOSE (this will prime the line from the pump). This is a test run, so do NOT put any acid or other cleaning agent into the Reservoir. Attach the Keg Connector to a keg to be cleaned and mount it on the Reservoir.

The cleaning cycle sequence is as follows:

- 1. OPEN the DRAIN valve, allow keg to depressurize and discharge residual beer.
- 2. OPEN the WATER valve then OPEN the AIR valve, wait 30 seconds then CLOSE the WATER valve, wait until all water is discharged from keg then CLOSE the AIR valve, allow keg to depressurize.
- 3. CLOSE DRAIN valve, OPEN RETURN valve, OPEN ACID valve, turn Pump ON, OPEN the AIR valve, wait 60 seconds then CLOSE ACID valve, turn Pump OFF, wait until all acid is discharged from keg then CLOSE AIR valve, OPEN DRAIN valve, CLOSE RETURN valve.
- 4. OPEN the WATER valve then OPEN the CO2 valve, wait 30 seconds then CLOSE the WATER valve, wait until all water is discharged from keg then CLOSE the DRAIN valve, wait 2-3 seconds then CLOSE CO2 valve.
- 5. Dismount keg and disconnect Keg Connector.
- NOTE: If you don't have access to compressed air, all of the above AIR functions can be performed using CO2 instead, but not the other way around CO2 must be used in Step #4 to purge oxygen from the keg!

To clean kegs for real, add cleaning agent to the Reservoir per the manufacturer's instructions. You should be able to clean about a dozen kegs before the cleaning solution gets too dirty or too cool to be effective. A word of caution – you need to make sure the RETURN LINE is secured to the pipe inside the Reservoir because you will get sprayed with hot acid solution if it gets loose. The use of safety goggles, gloves, and protective clothing is also highly recommended. Of course, if you are one of those Know-It-All types who thinks he is invulnerable, you are free to ignore these warnings and take your rightful place amongst the other candidates for the Darwin Awards. Ok, that's it. Enjoy using your keg washing system. If you need help or clarification you can contact me via the "Contact Us" function on the Brewing News website – www.brewingnews.com – Attention Thrifty Gadgeteer. 'Bye!

Yours for economic functionality, The Thrifty Gadgeteer