

Efficient Grain Handling Systems or How to Save Labor Costs and Your Brewer's Back

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One of the last things people think about when designing and installing a new brewpub is grain handling. Most people are so concerned with tanks, floors, electricians and plumbers that the grain system often gets lost until the end.

An efficient grain-handling system will save you cash on raw materials, and will deliver potential savings on paid labor, liability insurance, worker burn out, and paid training.

Many brewpubs opening on a budget feel they can afford to pay more later in labor than a little more up front for an efficient grain handling system. In my opinion, this is a mistake. Aside from the added time (labor costs), one of the most common injuries to brewers is a back injury. Brewing beer for a living is a physically taxing job. It seems sensible not to make it more work than necessary.

In this speech, I will briefly describe three different but equally inefficient grain handling systems presently in use at three west coast brewpubs. The grain is handled (lifted, carried, pushed, or pulled) by the brewer up to seven different times before mashing-in. The brewers at these brewpubs agree that their grain handling systems are not efficient, although they have done the best they can under the circumstances, and they should be commended for that.

I will also describe the grain handling system which I designed for Steelhead Brewery & Cafe in Eugene, Oregon, where only the specialty grain is handled, and then only three times, before mashing-in. I will also describe the advantages and disadvantages of each system, which may be fairly obvious from the systems' descriptions. There will be slides showing the various systems as well as two diagrams and the list of suppliers.

The scope of this paper does not include the handling of spent grain.

Definitions

Before I begin, I would like to define some terms and equipment for clearer understanding.

Auger: Also known as a Screw Conveyer. An auger is a long tube with a long corkscrew-like shaft snaking through it. An attached motor rotates the shaft, moving the grain forward through the tube.

Straight Auger: The standard type of auger. The tube is straight and is made of steel. The shaft looks like a solid core corkscrew and is rigid.

Flexible or Flex Auger: A relatively new technology. The tube is made from sections of plastic PVC (polyvinylchloride) tubing. Curved sections can be used. The shaft looks like a giant flat spring and is flexible. The first flex auger I know of was installed at the 20 Tank Brewpub in San Francisco in 1990.

Silo: Also known as a Malt Bin. A silo allows you to receive your pale malt shipments in bulk rather than by the 50 lb sack. Besides the convenience of not having to lift and carry as many 50 lb sacks, it reduces the price of Steelhead's pale malt by 6.5 cents per pound. Considering that the silo holds approximately 15,000 lb of malt, Steelhead saves \$975.00 each pale malt shipment. Steelhead receives shipments approximately 5 times a year, so the annual savings of using a silo for pale malt storage are approximately \$5000. Most silos do not cost over \$5000, so a silo would most likely pay for itself within one year, depending on annual production needs and installation costs.

Weigher-Dumper: A space-saving method of weighing bulk malt. A weigher-dumper is counter weighted between 12-20 lbs. Ours is calibrated to dump at 15 lbs. The weigher-dumper has a counter on it to keep track of the number of dumps. The attached counters come in either analog or digital form. Digital requires electrical hookup. Ours is analog because our fire marshall required that everything in the mill room be explosion proof and the digital counter is not. The silo auger delivers pale malt from the silo, the weigher-dumper weighing and dumping every 15 lbs with the counter keeping count. This procedure is repeated up to the total quantity of pale malt desired, IE: 40 "clicks" = 600 lb.

Bin-hopper: A closed bin or hopper that is found between Steelhead's Weigher-Dumper and the mill. I had ours custom fabricated from stainless steel by Pacific Stainless in Portland, Oregon. The specialty grain enters the mill through the bin-hopper door.

Grist Case: A mild steel or stainless vessel whose function is to hold the grain after milling but before mashing in. This vessel is especially necessary if you do not have the advantage of gravity, IE: the entire brewhouse and associated operations are on the same floor.

Three Case Studies

The three brewpubs with less efficient grain-handling systems of which I will speak are:

Triple Rock Brewery, Berkeley, California.

Willamette Brewery, Salem, Oregon.

Rubicon Brewery, Sacramento, California.

First of all, I would like to say that none of these brewpubs have inefficient breweries, are inefficiently run, or in any way have a design flaw so as to cause them to produce inferior beer. On the contrary, these breweries have worked with their inefficient grain handling systems, and all of them produce excellent beer.

Triple Rock Brewery, Berkeley, California

Triple Rock is the granddaddy of the California brewpubs. It was limited in its original grain handling system both by its building, and its suppliers. When Triple Rock began brewing in December 1985, its malt had to be custom bagged by hand because their malt supplier did not own a bagging machine yet. Installing a silo for bulk grain deliveries was not feasible because the minimum order for bulk grain was 40,000 lb per shipment.

Originally Triple Rock had their mill and grain storage onsite. The space in their vintage building is very limited, and predefined because of the supporting walls. The business grew quickly and Triple Rock was forced to move its grain storage and milling facilities to a warehouse one mile away from the brewery. That has created the extent of inefficiency that their brewers are working with today.

I was the Head Brewer from July 1989 to August 1990. For the first six months I was there we received pale malt shipments in 80-pound sacks at the warehouse. After six months Reid Martin, an owner, installed an 18,000 lb grain silo in the warehouse and we were able to receive pale malt in bulk. I will describe the grain handling after the silo was installed.

Approximately 400 lb of pale malt and approximately 100 lb of specialty malt are used per average batch.

Grain-handling procedures:

Milling

A brewer drives to the warehouse one mile away in the company pick-up truck. Measure the entire quantity of pale malt from the silo into a hopper hanging from a scale which was suspended from the warehouse I-beams. Mill the pale malt into 32-gallon garbage buckets. Carry the 50-lb specialty grain sacks up four steps to a platform and open the bags one at a time. Lift the 50-lb bags and pour the contents into a hopper above the mill. Mill the specialty grain into more buckets. Put lids on the buckets and drag them outside. Heft them one at a time from the loading dock up over the tailgate of the pick-up into the truck bed. Once all buckets are in the pick-up, tie the buckets in place so they won't shift on the drive back to the brewery. Drive back to the brewery, unload the buckets at the curb. Use hand-truck to bring buckets inside.

Mashing

Mashing-in requires two people at Triple Rock. It was designed that way.

One brewer stands at the Mash Tun at the top of the brewing platform mashing-in with the canoe paddle.

The second brewer stands at the ground level next to a bucket-auger which has been lowered from its usual storage position up near the ceiling. This brewer scoops grain out of a 32-gallon bucket with a 2-gallon bucket and pours the grain into the bucket-auger, going as fast as he or she can.

Analysis

Most of the grain is handled (lifted, carried, pushed, or pulled) by the brewers seven times before mashing-in. Five of those times after milling:

- 1 - Specialty grain carried up four steps.
- 2 - Specialty grain sacks lifted and poured into the hopper.
- 3 - Buckets of milled grain (pale and specialty) dragged out to waiting pick-up.
- 4 - Buckets of milled grain lifted over tailgate into bed of truck.
- 5 - Buckets of milled grain lifted down from tailgate to curb.
- 6 - Buckets of milled grain pushed into brewery using hand-truck.
- 7 - Buckets of milled grain unloaded into bucket-auger using a 2-gallon scoop-bucket while mashing-in.

Willamette Brewery, Salem, Oregon

Willamette Brewery was designed with a fairly labor-intensive grain handling system because of the limitations of the building and other financial considerations. Jeff Cruise, the owner and brewer, gave me a tour in January 1993 and described the grain-handling system to me. Willamette receives all of its grain in 50-lb sacks.

Approximately 615 lb of total malt is used per average batch.

Grain-handling procedures:

Milling

A brewer goes to the basement of the split-level 3-story brewpub building. Lift the 50-lb sacks one at a time, and pour the contents into a hopper 6-feet above the ground, which is over the mill. Mill 125 lb of grain into a wheelbarrow. Push the wheelbarrow across the basement and onto a service elevator. Take the elevator up to the second floor. Push the wheelbarrow across the floor to the grist case. (The grist case is suspended between the first and second floors.) Pour the grain from the wheelbarrow into the top of the grist case. Push the wheelbarrow back to the elevator. Ride elevator down to basement. Repeat milling procedure and elevator trip an average of 5 times.

Mashing

Mashing-in requires one person.

Brewer stands on the brewing platform in front of the Mash Tun and mashes-in with a canoe paddle. The grain falls via gravity from the suspended grist case into the Mash Tun on the first floor.

Analysis

All the grain is handled (lifted, carried, pushed, or pulled) by the brewers four times before mashing-in. Three of those times after milling:

- 1 - Pale malt and specialty grain sacks are lifted and poured into the hopper six feet off the ground. (Not by me, obviously!)
- 2 - A wheelbarrow of milled grain is pushed to elevator, and taken by brewer up to second floor.

3 - Wheelbarrow of milled grain is pushed from elevator to grist case.

4 - Wheelbarrow of milled grain is emptied into grist case, and the empty wheelbarrow is then returned to the basement on the elevator.

Note - Above four steps are repeated 4 more times. Although this adds up to a lot of starts, stops, and elevator trips for the brewer, each unit of grain is only handled four times.

Rubicon Brewery, Sacramento, California

Rubicon originally used pre-milled malt in 50 lb sacks, because the cost of a mill was prohibitive. When it acquired a grain mill, the brewers creatively set up the grain-handling system, which I will describe.

Rubicon receives all of its grain in 50-lb sacks, and the brewers are looking forward to installing a 15,000 lb pale malt silo. I have not seen Rubicon's system, it was described to me by the Brewmaster, Phil Moeller.

Approximately 600 lb of total malt is used per average batch.

Grain-handling procedures:

Milling

A Brewer goes into the mill room. Lift the 50-lb sacks and pour the contents into a hopper above the mill. A device holds the empty sack below the mill. Turn on the mill and mill the grain back into the sack. Repeat for all grain. Carry open sacks of milled grain to a rolling platform ladder going up to the mash tun. Carry open sacks up 5 steps, one at a time.

Mashing

Mashing-in requires one person.

Brewer stands on rolling platform ladder in front of mash tun and lifts each bag of grain and pours it into the mash tun. When all grain has been dumped, stir with a canoe paddle.

Analysis

All the grain is handled (lifted, carried, pushed, or pulled) by the brewers four times before mashing-in. Three of those times after milling:

- 1 - Pale malt and specialty grain sacks are lifted and poured into the mill hopper.
- 2 - Sack of milled grain is carried to rolling platform ladder.
- 3 - Sack of milled grain is carried up 5 steps of platform ladder.
- 4 - Sack of milled grain is poured into mash tun before mashing-in.

Automation: Making the system less labor dependent!

As you can see by these three examples, the brewer is required to lift, carry, push or pull the entire quantity of grain per batch up to five times, and the specialty grain up to seven times before it is even mashed-in!

The most efficient way to design your grain-handling system is for the brewer to handle only the specialty grain and then only once: to lift the 50-lb sack and pour the grain into the hopper above the mill without carrying it up any steps. That is the optimum. At Steelhead I have tried to achieve it.

Steelhead Brewery, Eugene, Oregon

I became the Brewmaster at Steelhead Brewery four months before the doors were opened to the public. Before I started, the floor was poured and the tanks were already fabricated. Steelhead is very small, 5000 square foot total for brewery, kitchen and 150-seat restaurant. Because of these space constraints, the specialty grain storage facility had to be moved off-site and a silo was needed for the pale malt.

Luckily, one of the owners of Steelhead has a business across the street and we are able to store all our specialty grain in the second floor attic there. The grain is moved in and out of the attic on a service elevator. Because the grain is stored across the street, the brewers have to handle the specialty grain three times instead of once. Also, we were able to get a silo installed before we began test brewing.

Approximately 500 lb of pale malt and approximately 150 lb of specialty malt are used per average batch.

Grain-handling procedures:

Milling

A brewer walks across the street to where the grain is stored. Lift 50-lb sacks of grain onto a dolly or cart. Push grain across the street to the brewery. Mill half of the pale malt in the recipe. Pale malt is augered in from the silo. (Upon milling, all grain is immediately augered out from under the mill and up into a grist case.) Lift an average of three 50-lb sacks of specialty malt and pour the contents into a hopper above the mill. (Hopper is about four feet off the ground, so no need to carry sacks up any steps or lift 50-lbs over your head!) Mill the second half of the pale malt.

Mashing

Mashing-in requires one person.

Brewer stands on the brewing platform in front of the Mash Tun and mashes-in with a canoe paddle. The grain is moved from the grist case to the Mash Tun via a flex auger which is controlled from the control panel on the brewing platform.

Analysis

The specialty grain is handled by the brewer three times before mashing. It is not handled at all after milling:

- 1 - Specialty grain sacks are lifted onto cart or dolly.
- 2 - Specialty grain is pushed across the street.
- 3 - Specialty grain sacks are lifted and poured into bin-hopper.

Steelhead's System Design

I designed Steelhead's grain-handling system before the brewery tanks were installed. It was designed so that only one brewer is required on any brew day.

Pale Malt Storage

The pale malt is stored in a silo outside of the brewery building, on top of a small utility building in the parking lot. The grain is moved into the brewery building and into the mill room via a flex auger.

Augers

Using the manufacturers' estimated figures for the the following items: auger speeds, auger flow rates, capacity of the weigher dumper, and speed the mill crushes grain, I calculated the preferred diameters of the two flexible augers.

The Mill Room

The equipment found in the mill room include the following: The exit-end of the pale malt delivery auger and the auger motor. A 7-inch drop tube from the flex auger. A Roskamp weigher-dumper. A custom-made stainless steel bin-hopper. A Roskamp 2-Roller mill with attached straight auger which delivers up to 900 lb milled grain into the top of a grist case. A larger flex auger that delivers the milled grain from the grist case to the mash tun.

Detailed Procedures

Milling the Pale Malt

Set the analog dump counter on the weigher-dumper to 0. Set the mill grind setting for pale malt. Turn on both the mill and the silo auger. The 3-inch ID (interior diameter) flex auger delivers pale malt from the silo to the weigher-dumper. Every 15 lbs the weigher-dumper dumps the pale malt into the enclosed bin-hopper above the mill. The pale malt falls into the mill, and after milling, is immediately augered into the top of the grist case via the attached straight auger. The grist case is also in the mill room. Half of the pale malt called for in the recipe is milled. This will ensure that the bottom part of the grain bed in the mash tun is mostly pale malt, to ensure a smoother run-off. Turn off the silo auger when you have reached half the total "clicks" or dumps. When the mill is empty of grain, turn it off.

Milling the Specialty Malt

Reset the mill grind setting for specialty malt. (A little tighter grind is required for 6-row specialty malt than for 2-row pale malt.) Secure the lid of the bin-hopper open. Turn on the mill. Lift each bag of specialty malt and pour into the bin-hopper. When the mill is empty of grain, turn it off.

Close the lid of the bin-hopper.

Milling the rest of the Pale Malt

Reset the mill grind setting back to pale malt. Turn on both the mill and the silo auger. Mill the second half of the pale malt. The reason for this procedure is to clear out all the augers of any specialty malt. If this is not done, the residual specialty malt left in the augers will throw off the recipe of the next beer brewed. Turn off the silo auger when you have reached the total number of "clicks" required. When the mill is empty of grain, turn it off.

Grain movement from Mill Room to Mash Tun

All the grain required is now resting in the grist case. When the brewer is ready to mash-in, a push of a button on the control panel on the brewing platform brings the grain from the grist case via the 5-inch ID flex auger. This auger takes 3 curves and goes through three walls on its way to the mash tun. The grain is dropped into the mash tun from the auger through a removable square funnel attached to the flange on the mash tun with a removable rubber sleeve.

Mashing-in

After the foundation water is run into the mash tun, the brewer turns on both the 5-inch auger, and the mash-in water. The mash-in water is delivered via a spray collar, and enters with the grain.

The brewer uses a canoe paddle to ensure the grain is well mixed with the water. Mashing-in takes 8 to 10 minutes.

Conclusion

I feel it is very important to consider your grain handling system before installation of the brewing vessels. In fact, it is not too early to consider your grain handling system before you do any rehab work on the building you plan to use. In the case of two of the brewpubs, they are severely restricted by the constraints of their buildings. It is often easier to install something like a silo up front, than it is to retrofit the grain handling system in later. Case in point, if we had not put Steelhead's silo in its present location prior to opening the business, it would have been impossible to retrofit later because the location on top of the utility building would have been occupied by air conditioners and the fermenter glycol cooling system.

Also, when looking at the total cost of setting up a brewery, please try not to forget to figure in your grain handling system. As you know, breweries do not survive on kettles and fermenters alone. The raw materials have to be stored somewhere, and hopefully moved with ease throughout the brewing process.

If you are tight on funds, as most startups are, be sure to look into programs your suppliers may offer. For example, Great Western Malting Co. has a program to help you purchase your pale malt silo. You pay for the silo as you go, with the 6.5 cents difference between the bulk and bagged pale malt price.

Even without this deal, the cost of a grain handling system is paid for through pale malt price savings over time. And if raw material savings aren't enough, be sure to consider the savings on

paid labor. The time spent working around your grain handling limitations can add up. For example Willamette Brewpub and its 5 trips up an elevator with a wheelbarrow, or Triple Rock with its need for an insured company vehicle and time spent to get milled grain across town.

If you still don't think you need to concern yourself with a grain handling system because your strapping 21 year old nephew is willing to do it for cheap, remember this: Over time that nephew will want a raise. Over time that nephew will get older and less resilient physically. Brewing is a very physical job. Every brewpub is a small industrial beer factory. Injuries are common, the back injury is probably the most common injury in a brewery.

Microbrewing is still a relatively young industry, but please don't think for one minute OSHA isn't keeping its eye on us, it is. The more injuries that stack up, the more we'll all pay in liability and workman's compensation insurance. I have seen two brewers have to quit their beloved brewing jobs because of back injuries. In one case, after the insurance company had paid out over \$60,000 in medical bills.

Unnecessary extra physical labor burns people out. Without an efficient grain handling system, you could have high brewer turnover. Considering it takes 4-6 months to train a brewer well, that's a lot of money spent training people.

In conclusion, an efficient grain handling system will save you cash on raw materials, and will deliver potential savings on paid labor, liability insurance, worker burn out, and paid training.

*** THE END ***

Suppliers

Grain Handling & Flexible Augers

Gardner-Rossi

Ceres, California

(209) 539-5731 or (209) 834-5907

Fax: (209) 537-0910

Contact: Andy Hite

Weigher-Dumper and Mill

Roskamp Mill - CPM

2975 Airline Circle

Waterloo, IA 50703

1-800-366-2563 or (319) 232-8444

Contact: Linda Kruckenberg

Silos

GSI (Grain Systems Inc.)

Turlock, California

(209) 667-6891

Fax: (209) 668-7844

Contact: Bud Gustafson