The Correspondence Course

Wheat Storage

(Conducted by J. O. THOMAS)

THE sizes of silo bins depend, of course, upon the miller's requirements, but it is essential to have, besides the large, primary storage bins, a number of smaller ones to accommodate small parcels of wheat and residues from the large bins, so as to release storage space for new supplies as they arrive. For instance, we might have a bin of 800 qrs. capacity that contains 100 qrs. of Australian wheat. We might require space to accommodate a large delivery of Manitoba—but that 700 qrs. storage space must remain unused unless the odd cotchel (" cotchel " is a millers' term for a small parcel of grain or seed ; we do not know its origin) can be put into a smaller bin. Small parcels of grain, when delivered, should be run into small bins. For these reasons, half-bins and quarter-bins are essential to all silo installations, and they are provided usually by sub-dividing primary bins.

In the case of large mills, it may be necessary to make some arrangement for receiving wheat and reloading it into barges or bulk road and rail wagons to supply the needs of subsidiary mills. For this purpose, " outward delivery " bins may be set aside. These are connected to special outlet deliveries to enable the work to be performed without interfering with normal receiving, turn-over, or blending facilities. The wheat sent to the outward delivery bins would pass over a separate weigher, so that complete records could be made of any transference of grain to another mill.

Some mills might have to receive, during a very short period, large quantities of home-grown wheat. The latter, owing to prevailing harvest conditions, might contain an excessive amount of moisture, necessitating immediate drying if successful storage were to be assured. The drying of the " green " wheat at the rate at which it was received would necessitate a very large installation, and therefore, the work must be organized on more economical lines. To meet such a case, special bins, into which the green wheat is run as it is delivered, are provided. They are connected to a special drying installation, which is preceded generally by a separate receiving separator. When in operation, the plant is working throughout the 24 hours, and therefore, it need not be of as great a capacity as a plant required to work only about eight hours per day. Hence, its capacity need be only 33⅓ per cent. of the receiving rate to keep pace with the actual deliveries. The separator, called upon to handle the reduced quantity, would make a more complete separation of extraneous materials, light beeswing, chaff and dust (the removal of which is necessary for the successful operation of a modern dryer).

Using the correct type of dryer, it is possible to extract six per cent. of natural moisture in one operation, based on a reduction from 20 per cent. to 14 per cent. The latter figure can be regarded as a safe moisture content for successful storage. As will be seen when we consider the conditioning process, the extraction of natural moisture is not an easy matter, and it is essential that the wheat is cooled to atmospheric temperature as well as dried successfully.

After the dried wheat has been in its bin for two days, it is good practice to turn it over into another bin. The wheat will receive an aeration that will check any tendencies to heating, and if it is possible to include an aspirator in the turn-over run, so much the better.

Turning Over and Pre-Damping

The importance of providing a turn-over system, which can be operated independently of any receiving or blending installation, cannot be over-emphasized. The miller must have flexible facilities for turning over wheat that may require aeration and for rearranging the distribution of binned wheat to obtain space for new deliveries. To be forced to stop receiving or blending wheat for the screenroom for the foregoing operations to be carried out, just for the lack of an extra elevator or so, is poor organization. The turn-over elevator should be of the same capacity as the main receiving elevator, to enable the work to be carried out as quickly as possible. Where measurers or weigher-mixers are fixed under the main storage bins, possibly limiting the rate of discharge, a by-pass spout should be installed, so that the wheat can be drawn off, at times, at a rapid rate. If it is necessary to empty a bin to obtain storage space, it may be necessary to do the job very quickly.

The turn-over system might be arranged, also, for the pre-damping of very hard, dry wheat. From our recent studies of wheat characteristics, we know that we are called upon, at times, to handle exceptionally hard and very dry wheat that requires very thorough conditioning, involving, maybe, the absorption of anything up to eight per cent. of added moisture. (Forbear to speculate on the colossal source of profit represented by such water addition. Generally, these very dry types, such as Persian, which sometimes receive eight per cent. or nine per cent. of moisture, contain an excessive amount of unsaleable impurities, dried mud, sand and stones, that go far to offset any such hypothetical gains). The high water addition cannot be achieved in one operation in the screenroom, and often, as in the case of hard structure Manitoba, pre-damping is the solution. The operation should not be carried out indiscriminately. It should be under complete control, and the damped wheat should be sent to bins specially reserved for it, from which it can be worked in rotation.

Pre-damped wheat must be allowed to lie in the bins to allow the moisture to penetrate the hard structure grains. On the other hand, we do not advocate pre-damping wheat that would have to remain in store for weeks before it was used. A period of seven to ten days' standing should be adequate for even penetration of the added moisture to take place.

Pre-damping has several disadvantages. A very large damper is required to deal with the large quantity of wheat received. The fluctuations of this large quantity of wheat may, in itself, cause mechanical difficulties in operating the damper, which will tend to race when the full feed is on and to ease up with a slower rate of intake ; and it must be borne in mind that a fluctuating flow is common to all methods of intake—suction plant, bucket elevator, or hand-tipping. The result is that the damping of the wheat is uneven, even though some types of large damper are fitted with brakes to check the tendency. There is, further, the difficulty of trying to ascertain the extent of the damping that has been effected.

With a separate damping plant, incorporated in the turn-over system, a uniform flow of wheat can be regulated and calculated. Let us suppose that we have a stream of wheat, to which we wish to add three per cent. of water, discharging from a bin at the rate of 40 qrs. (480 lb.) per hour. This is equal to 19,200 lb. of wheat per hour, and the amount can be checked by sacking off the stream for a period of five minutes, weighing the grain and multiplying the figure obtained by 12.

Three per cent. moisture addition to 19,200 lb. = 576 lb. of water at 10 lb. per gallon = 57.6 gallons.

The damper should be set to lift from the water supply tank 57.6 gallons per hour to be piped along to the damping worm to join the wheat. Some loss will occur, of course, for it cannot be expected that all the water will be picked up by the wheat, but if we make a slight allowance for wastage, fairly accurate damping will result. To check the water addition, we must put a measure on the water stream from the damper and ascertain the quantity that is being delivered in a certain time. A two-gallon petrol can is quite a convenient measure, and if we allow our 57.6 gallons an extra 10 per cent. for wastage, making the figure 63.5 gallons per hour (approximately), the two-gallon can should be filled with the damper water in just under two minutes—1 minute 53½ seconds, to be precise—and the damper should be regulated to discharge this quantity.

At this point, we must remind students that when damping operations are concluded, the supply tank should be emptied and cleaned, ready for its next usage. A drain cock should be fitted to facilitate the job. Draining and cleaning are important, for a damper may remain unused for many weeks, and water allowed to linger in the tank, perhaps with germinating or rotting wheat in it, quickly becomes foul ; when the installation is restarted, this filthy fluid will be emptied all over the first wheat to enter the worm.

If more than three per cent. of water is to be added, double damping should be employed. The damping is done in two operations, with sufficient lying time between to allow the moisture thoroughly to penetrate the grain. If a large percentage is added in one operation, there will be too much surface moisture on the freshly-damped grain ; it will run down to the bottom of the bin, and the wheat in the hopper will be over-soaked, with the result that grain will not deliver from the bin.

Special damping bins are necessary because they do not deliver cleanly ; it is very necessary to clean the hoppers periodically, otherwise they will be covered, after a period, with heated, rotting grain. The wise miller will keep his damping bin hoppers under strict surveillance.

Types of Dampers

In order to introduce the water to the wheat, a damping worm is necessary. This consists of a worm in a metal trough, which enables the water partially to be assimilated by the grain, although a great deal remains on the outer bran surface. Penetration does not become complete until the wheat has been binned for a period. The pipe line carrying the stream of water must be fixed at a point after that at which the wheat enters the worm. We prefer to have the pipe line fixed in such a way that it delivers into a wide mouth removable funnel which allows for the measuring test we have described ; furthermore, the water stream is visible, so that the operative in charge of damping can watch the stream every time he is in the vicinity. The damping worm should be at least five feet long, and should be of such a size that it can be driven at a comparatively slow speed that will permit uniform damping and a certain amount of immediate water absorption, as described in the first of the "Technical Teasers" that appeared in this Journal.

Damped wheat conveyors require considerable extra driving power, and therefore, it is bad policy to have long damping worms. The latter frequently stop and choke, and in addition, there may be ruined driving belts. The only remedy is to shift the damping installation to a point nearer the delivery of the conveyor, or better still, to instal an additional short worm, specially for the actual conveying.

Students should study the designs and methods of control of the different types of automatic damping machines. The water wheel damper, for instance, consists of an encased, pocketed wheel, on to which the stream of wheat is fed at such an angle that the wheel is revolved by the wheat itself. Attached to the encased wheel, by means of a central spindle, preferably revolving in ball bearings, is a larger wheel, to which are attached buckets (which may be of various sizes). The bucket wheel revolves in a water tank, fed from the main water supply and maintained at a constant level by means of a ball valve. As the wheel revolves, the buckets pass through the water, thus becoming filled ; and as they turn over for the downward sweep, the water leaves the buckets and falls into a sloping collecting tray. A rubber pipe line attached to the tray conveys the water to meet the wheat (that operated the internal wheel) in its passage through the damping worm. The buckets can be removed from the water wheel, or, in some cases, can be reversed to pass backwards through the tank without lifting any water. Thus, the amount of water lifted can be controlled by using a set number of buckets, and as the wheat itself operates the wheel, the action is entirely automatic. The larger the quantity of wheat, the faster the speed at which it drives the wheel, and *vice versa*. When the flow of wheat stops, the wheel stops too.

Another useful type of damper is constructed on the same principle, but instead of a wheel, an eccentrically fitted rod operates a pump that works on the water supply tank. To regulate the quantity of damping water, the position of the rod on the arm of the pump is raised or lowered, thus increasing or decreasing the amount of eccentric stroke movement, and hence, giving a large or small pumping action. This type controls the addition of moisture more accurately, but the pump cannot be operated by small capacities of grain.

Measuring meters are often fitted to the water supply to the regulating ball valve, but as a rule, it is possible only to obtain a reading of the quantity of water that has been sent to the damping worm over a fairly long period. That is why we outlined our method of ascertaining the flow of water to the wheat by actual measurement in a vessel of known capacity.

A by-pass spout always should be incorporated in the feed to the damper, so that the wheat can be diverted when no damping is required, and also, to permit repairs to the mechanism. Finally, it should be noted that damping is best performed at the top of the silo, before the wheat enters the bins.

Ventilation of Bins

A proportion of the bins in the silo should be ventilated. It is not necessary to apply the ventilation continuously to normal types of wheat, but there are occasions when grain is received in an overheated condition or when it has an excessive moisture content but, for some reason, cannot be dried. Such wheat could be put into the ventilated bins, which would have two crossed louvres or air ducts at the discharge hoppers. A reliable fan, connected by trunking to the outside openings of the louvres, would move air into the bins (which would be open at the top). Heat always rises, and an upward draught of air could easily be set in motion through the binned wheat. We are convinced that British millers do not take sufficient advantage of this easy method of ensuring safe storage. Ventilating bins are not an alternative to pre-drying green wheat ; they should be regarded as an augmentation of existing facilities.

Questions (Intermediate Grade Only)

1.—Draw carefully a water-wheel damping installation, and describe its action.

2.—What is meant by "turning over?" Make a drawing of a silo, showing clearly the turning-over facilities.

3.—How does a travelling throw-off carriage work? Make a drawing to illustrate your answer.

4.—At what points throughout the intake plant and silos should exhaust be applied? Why? What types of dust collector would you advise?

Why Grain Should Not be Sprouted

Hydroponics is the technical name given to soil-less gardening or tank culture. In reply to an inquiry, the editor of *Eggs* said he does not consider that sprouting grain is a great advantage. It changes the form of the food, but tends to decrease its nutrient value, which would be still more decreased if the oats were sprouted to as much as eight inches. They would satiate the appetite without nourishing the body. He recommends soaked grain, however, and considers that grain soaked for twelve hours is better than sprouting grain to eight inches or so. It has the same effect in making it more digestible but does not deprive it of any of its nutriment. Grain after twelve days' sprouting would be merely succulent, but there would be no mineral matter for that is derived from the soil.