LOW HUMIDITY STORAGE ROOMS
David L. Watson

I would like to thank Dr. H. Dean Bunch and the organization here at Mississippi State for the honor and the opportunity of speaking to you today about some of the problems of dry seed storage rooms.

I am sure there isn't a person in this room who hasn't come face to face with the problem of damp air in the storage of seeds. You all know that high humidity causes loss of viability, disease and germination in storage. Also, damp air and, therefore, damp seeds tend to invite insects. Boxes, bags and packaging materials tend to crush, discolor and rot. High humidity adds up to loss in your storage program -- while humidity control can mean dollars in your pocket.

I have talked to one corn breeder who estimates his foundation and breeding stock to be worth a penny a grain. This company found that a dry room for foundation, breeding and carry-over stock was a financially sound investment. They are raising a large crop of foundation seed which they plan to hold for as long as ten years and thereby eliminate annual small crops. A properly controlled dry room makes this possible.

Let's talk for a few minutes about the costs and consideration in building and drying a room for your seed storage program.

First of all, we must realize that we are not dealing with liquid water. Too often we can't get away from this concept. We know that water exists in three forms -- a solid, a liquid and a gas. We are dealing with a gas which we cannot see and which we cannot feel. This gas pushes itself from place to place by its own pressure. Therefore, when the air surrounding seed is dry, the seed gets dry, and, if the air is damp, then the seed gets damp. If you have ever tried to shave in Arizona, you will get the idea. You find that before you can shave, the lather gets dry. You might say that the air in Arizona is thirsty. It dries things up fast. You have to lather a little and shave a little to get the job done. Herb Shriner of television fame once said it was so dry they put on postage stamps with safety pins.

Let's consider for a moment the moisture in this room. I am quite positive that we have at least 70 to 100 grains of moisture per pound of air here now. What does this mean? We can't see it and we can't feel it. I am pretty sure we have this much moisture because each person while just sitting here will add about 1/4 of a pound of water to the atmosphere during the hour. We

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do this by breathing and by evaporation from our skin surfaces. If we cooled this room down to 50°F we would begin to see this moisture because it would condense all over every object in the room. The relative humidity would increase to 100% and seeds stored here would germinate and rot.

We have all seen those small mechanical refrigeration-type house-hold dehumidifiers. We could place one of these in the corner and after it ran for a day it would collect a bucket of water. We would get something we could see and feel. It would be tangible, and we as humans tend to like this sort of thing. As we dump out a bucket full a day, we feel accomplishment. If we measured the relative humidity before and after collecting a bucket of water, we would find the measurements to be very nearly the same -- and we ask why? Simply because, as we dehumidify, the air moisture by its own pressure comes in through the plaster, cement, wood, bricks and around the cracks in the doors and windows. We would find that to effectively dehumidify this room, we would have to have a very large and very expensive dehumidifier indeed.

What are we saying? Simply this -- in order to have a dry storage room, first you have to have a storage room which is capable of being dried. We have said "we are dealing with a gas". We don't find gas delivered to laboratories and homes in a "wooden" keg! Water can be kept in a keg but gas must be contained in a metal tank or a glass jar. Gas can only be contained in an enclosure that is gas-proof or in this case, vapor-proof.

A dry storage room must be constructed so that it approaches the state of being gas tight (not water-proof). If it is an existing room, then we must make it as vapor-tight as possible by the use of vapor-proof coatings or by lining it with an effective vapor barrier. Remember! A good thermal barrier is not necessarily a good vapor barrier and a waterproof material is not necessarily vapor proof. We are not talking about selecting an insulation with a vapor barrier on one side and tacking and stapling it here and there; we are not talking about sealing the walls and letting the ceiling go; we are not talking about doing a good job on the walls, floor and ceiling and then installing a door that leaks all the way around. We are talking about fanatically sealing every crack in the entire structure. This is the most satisfactory and least costly way. It is worth dollars and it must be done.

Perhaps it's because I am in the metal fabricating business but if I were doing it, I would build the entire room of sheet steel or sheet metal. I would weld every joint or I would seal it with a positive gasket and I would use a commercial ice-box door that seals. Perhaps this sounds too costly but let's consider a moment. In my home town, they are building 1500 aluminum houses. Prefabricated metal buildings are for sale nationwide. Steel quonset huts have been in use for many years. Actually, this is a very practical way to build a dry storage room. After you have overcome the vapor proofing job, you can use any good waterproof thermal insulation you choose, depending on what temperature you intend to maintain.
I strongly suggest that you go back and read again the 1960 Short Course Proceedings. On page 162, John S. Rogers states the ultimate importance of low humidity and I quote, "while reduction from 12 to 11% (seed content) will double the period before substantial loss of vigor, reduction from 12 to 10% will increase it by 4 times." If this is true, then it is plain common sense that we should seal the storage room to hold the humidity to a low level during all seasons of the year.

Again I say, if you are planning to use an existing room, be practical and do the very best sealing job possible.

Our next problem is to select a dehumidifier which will maintain low humidity. We are not talking about just a reduction in humidity, and we are not talking about how many buckets of water we can collect. Our problem is to keep the air dry to a much greater degree than we might attempt in our basement at home. We are talking about Arizona-dry and Egyptian-tomb dry. This is one reason why a lot of people are in trouble today. The actual degree of dryness required was not really faced in the first place. So let's talk about 50°F, 20% r.h., or 40°F, 30% r.h. to start with. It is very difficult to accomplish this degree of dryness with refrigeration equipment alone.

The most practical known method of drying to this extent is with a desiccant dehumidifier.

Please don't be alarmed by the word "desiccant". Too often people think this is a chemical like calcium chloride which is consumed as it dries, is corrosive and messy to handle. Desiccants are not like this. I brought several samples with me which you can examine if you would like to. These are dry chemicals, non-toxic and non-corrosive. They will last for years without losing effectiveness. You could use them in your salt shaker without danger. It will not hurt your hands or sting your eyes and it will not harm your seed.

The machine blows air from your storage room through a bed of desiccant. The desiccant takes out the moisture and the dry air goes back into the room. After the desiccant collects a quantity of water, the machine automatically switches the air stream to a fresh bed of desiccant to continue drying while the first bed is reactivated by blowing hot air thorough it. The moisture, still in vapor form, is blown outside the room and you never see any water. Thus, while one bed is always drying, the other is always regenerating. This is done simply and automatically and the machine can be left alone to run for many months without attention.

The machine can be mounted inside or outside the storage room. A humidistat can be installed in the room to cut the machine on and off, thereby maintaining a constant condition for your seeds and saving power.

A desiccant dryer has to contain the air that passes through it and, therefore, should be constructed so that it is vapor-tight. It must withstand
the effect of condensation. For this reason, it should be made of heavy gauge steel, (14 ga. minimum), and should be continuously seam-welded. Some machines are spot-welded and the cracks are sealed with a soft pate-type sealing compound. This is not considered to measure up to a continuously seam-welded machine.

All machines must have air diversion valves. These valves are very important to the operation of the machine. If they leak air, it will effect the humidity in the room. The best valves I know of are cast aluminum with micarta wiper blades. These last for the life of the machine. The wipers will never wear out and they are compact and usually arranged for accessibility and easy maintenance. Beware of sheet metal fabricated valves with neoprene cups or discs. These are difficult to get to, difficult to adjust, and the neoprene soon hardens due to the heat. On this type of valve, you usually have to remove the duct work from the machine to adjust them. I know of one machine where 70 sheet metal screws have to be removed as well as the duct work, in order to get to just one of the valves. This type valve also tends to require more maintenance than cast and machined valves.

Desiccant beds are made in horizontal, vertical flat, and vertical cylindrical styles. Vertical cylindrical beds are by far the strongest and most rigid. They should always be made as a separate machine part. Some manufacturers make the bed an integral part of the machine. This is bad because, if a hole appears in the bed screen, the machine casing must be discarded.

Don't be taken in. Even though you don't understand the equipment, use your common sense. Ask questions.

Blowers, heaters, valves, desiccant beds, and all component parts should be replaceable and accessible for service without removing the ductwork and without major dismantling of the machine. Flanges should be bolted, sheet metal screws should be avoided. Spot welded machines are inferior. A good dryer made by a reputable manufacturer will last for 20 years or more and will give good service. Be practical - check on the features of the dryer itself. Don't be swayed by high performance curves which you cannot check.

Dehumidifier initial costs vary with the size and condition of the storage room. Average cost dryers for seed rooms range from $700.00 to about $2,000.00 depending on the particular situation. I would say that generally a 400 cfm machine with a 4 KW electrical load at a cost of about $1200.00 will hold a low humidity in an average storage room of 5,000 cubic feet. If the room were very well sealed, it could be as large as 10,000 cubic feet.

I hope that what I have had to say will help you as you approach dry room problems. The inherent difficulties caused by poorly constructed storage rooms, poorly designed equipment and undersized installations, have discouraged many people. By taking a logical and proper approach from the outset, humidity can be economically controlled and you can save dollars with a dry seed storage room.
Una-Dyn Desiccant-type Dehumidifier

The illustration above shows how a desiccant unit works. Humid air enters the dehumidifier at the humid air inlet. This air is filtered and then flows through the desiccant bed where it is dried. It is then forced out at the dry air outlet.

At the same time, air is drawn into the machine at the reactivation air inlet. This air is filtered, forced through the valve, across a heater and then through the desiccant bed that has become damp. Here, the heated air removes the moisture and thus reactivates the bed. This air then flows through the valve and is exhausted through the reactivation air outlet carrying the moisture with it in vapor form.

While one bed is drying air the other is being reactivated. This shifting from bed to bed is automatic and works in a continuing cycle. The dry air stream and the reactivation air stream are completely separate.