It has been said that laboratory experiments do not tell the true story regarding an installation on a commercial scale. But, if, during the laboratory tests, the controlling conditions are made to approximate those of the commercial operation, they should and do tell the exact truth. All governing conditions, critical temperatures, time limits for chemical reactions, if any, and all data on the character of the materials to be handled, should be in hand for study before laying out the system.

Unfortunately, however, in most cases where high temperature drying can be applied to best effect, the client is either reluctant to give up any data for fear of giving away trade secrets, or he does not know many of the characteristics of the materials he handles.

All chemical actions are effected by heat, and the most of them are not completed, and some will not even start at all, without a certain critical temperature of heat. In the case of metathesis, where two separate chemical combinations are broken up and two or more totally different combinations are formed by the interchange of the elements of both groups, there are several actions or reactions at once. There seems to be no data on how much heat is absorbed by these actions.

Strange to say, in the case of many of the liquids, oils, gums, etc., in use for commercial purposes, the specific heat, and latent heat of evaporation and fusion, are unknown and one has to assume them to be the same as for water. Also a gum which will only melt when in bulk subjected to a temperature of 450 deg. fahr., as in a kettle, will carbonize when subjected, as a thin coating, to a temperature of 250 deg. fahr.

It is therefore necessary to do a considerable amount of testing in the laboratory in order to establish the controlling conditions in each case. The usual result is that when we have succeeded in fixing the critical temperatures, time limits, etc., and have cut the time for processing in half, the client immediately begins to figure where he can save some more money in the process and by the time the system is installed we find he has substituted creosote oil for anthracene oil, or fish oil for linseed oil, or he works in a non-hardening hydrocarbon oil, uses clay instead of magnicite, or in the case of a coating, puts it on twice as thick and makes one coat do for two.

In many cases the whole chemical formula is changed and notwithstanding the characteristics of the new material or coating, are totally different from the old, the manufacturer expects the results to correspond to the laboratory demonstration. From the manufacturer's point of view this is a good thing, for it sometimes enables him to cheapen the unit cost of his raw material as well as increasing the output by omitting elements which were required for the proper hardening at low temperatures while not for the high. But it leaves the engineer rather in the air until things have settled down to a standard of operation.

Hot dry air sometimes carries static electricity in a drier. This can often be overcome by putting a small steam spray into the air supply. Of course, this has to be taken care of in the amount of heat supplied, as the steam must be superheated. A glucoside or a gum dried to a powder by atomizing the solution through a current of heater air will come down so charged with static electricity that it cannot be put into a glass bottle. Fabrics coated into an oven over a carding roll become so charged, even with well-grounded coating machines, that a static neutralizer is sometimes required to kill the effect.

In many processes the materials leaving the oven, when done, are soft from the heat and have to be conditioned in dry air. If the conditioning air is at too low a temperature, the goods will sweat and mould. The air should be as dry as possible but at normal temperature.

Linseed oil and varnish coatings which in commercial practice on large scale and in low temperatures of 155 to 160 deg., require 8 hours to dry, will dry in 1½ to 2 hours with the drier effluent at 220 deg. fahr., the air entering at 300 to 350 deg. fahr. By the addition of free oxygen I have dried them in the laboratory in 30 minutes.

In drying, the linolein of linseed oil takes up oxygen which changes the linoleic acid to linoxin, giving up glycerin which disappears as water vapor and carbonic acid gas. If heated too hot, acrolein escapes. One pound of linseed oil requires 0.17 lb. of oxygen to oxidize it. Therefore, assuming that all the oxygen were to be used up in the process of drying, the minimum amount to supply 1 lb. of oil would be 0.85 lb. of air or, say, 14 cu. ft. at 200 deg. fahr.

In rapid drying probably not over 10 per cent of the total oxygen component in the air is used up, so that 140 cu. ft. of air per lb. of oil, or say 1,000 cu. ft. per gallon, is about the minimum to supply.

No hard and fast rule for speed of drying for definite temperatures can be used with linseed oil, for the reason that it is affected by the quality of the oil, the method of extraction, the aging, and the boiling. The process of oxidation is started in the boiling of the oil, and is then restrained or intercepted by cooling, until when it is mixed in the coating and reaches the drier, the action is set up again to continue from where it left off.

If the boiling is not properly done, or is not carried to the proper point, the oxidation process will not have been sufficiently set up and the action in the drier will not be uniform. The addition of an artificial drier, as Japan drier, or oil of powlownie, will not help matters, for it will discolor the finish and the coating will soon crack.

Aerated water has a highly oxidizing effect on metals. Oxygen being more readily soluble in water than nitrogen, the bubbles of air contained in the water often run as high as 40 per cent oxygen. Wrought iron pipes carrying aerated water rust very fast. Moist air is also highly oxidizing as shown by unprotected wrought iron left in a damp atmosphere.

But humidified air even at high temperature, has, as compared with dry air, a retarded oxidizing effect on linseed oil, varnish and other sicative coatings. This may be beneficial in the case of coatings on wood where too rapid hardening will cause craze cracks. For conditioning a dried surface, either dry air or a cold water spray will harden it, but a moist atmosphere, even if relatively cool, will not do so.

Since in the case of all such coatings, the process of oxidation is carried only far enough for a durable elastic surface, and never far enough for a carbonizing of the surface, I imagine the deterring effect of moisture