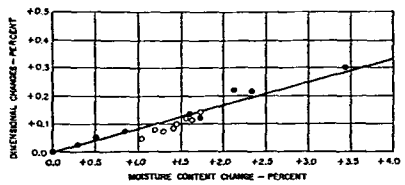

Fig. 2 .... Effects of Variation in Moisture Content on Dimensions of Printing Papers

Fig. 2 shows the straight line relationship between the moisture content of a sheet of lithographic paper and its dimensions.[1] The change in length of a sheet of paper for a given variation in moisture content will vary with the type of paper. Hard paper will stretch or shrink more than soft paper.

Since paper is a highly hygroscopic substance, it is very sensitive to variations in the humidity of the surrounding air. The moisture content of paper is changing whenever the amount of moisture in the sheet is out of balance with moisture in the surrounding air. The rate of moisture absorption or desorption of samples of lithographic paper that are not in equilibrium with the ambient air is shown in Fig. 3.[1] The rate of change of moisture content will vary with the different types of paper. Hard papers will stretch or shrink more rapidly than soft papers. The rate of air movement around the paper will also affect the rate of change of moisture content. The values in Fig. 3 are for individual sheets of lithographic paper hung from their corners, with both sides exposed, in a room with an air change every 30 seconds.

The rate of change of moisture content in stacked sheets of paper is much slower, and the moisture content (until equilibrium is reached) of an individual sheet will depend upon the location of the sheet in the stack. The time for a sheet in the center of a stack of 500 sheets to reach equilibrium is a matter of months rather than hours.

Wavy edges develop when a stack of sheet paper is exposed to an atmosphere with a high moisture content in relation to the paper. The cut edges where the fibers are exposed absorb moisture more rapidly than the center of the sheet. The edges therefore expand and cause the wavy condition.

Buckling is caused when a pile of sheet paper is exposed to air with a relatively low moisture content with the result that moisture is given up by the paper. Loss of moisture from the cut edges causes them to shrink, which results in a bulge or buckling in the center of the sheet.

Moisture curl is due to the effort of the paper to come to moisture equilibrium with the surrounding air. The porosity and fiber alignment of the bottom or wire side of paper is somewhat different from the top or felt side. Therefore, a change in moisture content of the paper will cause the paper to shrink or expand more on the wire side than the felt side which results in the tendency to curl. Curl can develop when the moisture content of the paper is not in balance with the relative humidity of the air. It also can occur when the paper comes in contact with the press moisture during offset lithographic printing.

Strength properties of paper are subject to change with extreme variations in relative humidity. At high humidities, paper loses tensile strength and is more easily stretched. The changes in strength properties of lithographic paper in the range of 45 to 55 percent relative humidity are not pronounced.

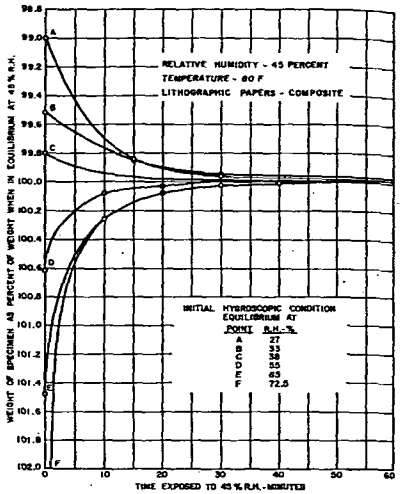

Fig. 3 .... Rate of Conditioning for Papers of Various Moisture Content

Static electricity charges develop most frequently on dry paper passing through the printing press in an atmosphere of low relative humidity. They may prevent proper feeding of sheets or cause clogging at delivery. Static charges also prevent the trapping of air between the sheets thus slowing the rate of drying. If the relative humidity in the press room does not fall below 45 percent, and the paper is in equilibrium with air at this condition, there will be sufficient moisture so that the static charges are dissipated as they are generated and will not build up to the point where they can cause trouble.

The three basic methods of printing are as follows:

1. Letterpress or relief printing in which ink is applied to a raised surface that does the printing. This is the most common method.
2. Lithography (planographic printing) in which the inked surface that does the printing is neither in relief nor recessed.
3. Gravure (intaglio) printing in which the inked areas are recessed below the surface.

MULTICOLOR OFFSET LITHOGRAPHY

The press room for sheet multicolor offset printing has more exacting humidity requirements than other printing processes. The dimensions of the paper must remain constant, and the paper must remain flat during multicolor printing in which the paper may make up to six or more trips through the press over a period of a week or more. If the paper does not have the right moisture content at the start, or if there are significant changes in atmospheric humidity during the process, the paper will not retain its dimensions

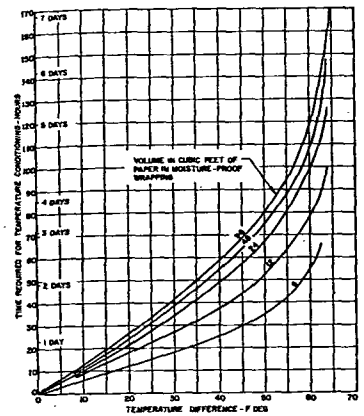

Fig. 4 .... Temperature Conditioning Chart for Paper

and flatness; and misregister will result. In many cases of color printing, a register accuracy of 1/200 of an inch is required. Examination of Figs. 1 and 2 shows the necessity of close control of the air relative humidity to achieve this result.

Maintaining constant moisture content of the paper is complicated because normally the paper will pick up moisture from the moist offset blanket during printing. The Lithographic Technical Foundation reports an increase in moisture content of 60 lb sheet paper of from 0.1 to 0.3 percent for each impression.[2] For this reason, it is desirable when two or more printings are made in close register work that the paper at the start of the printing process have a moisture content in equilibrium with air at a relative humidity 5 to 8 percent higher than the press room air. At this condition the moisture evaporated from the paper into the air just about balances the moisture added by the press. While a relative humidity 5 to 8 percent above the press room atmosphere is ideal for paper, the important consideration in obtaining register is to keep the sheets flat and free from wavy or tight edges. To do this, the relative humidity balance of the paper should be slightly above that of the press room atmosphere. This balance is not as critical in four-color presses because the press moisture does not penetrate the paper fast enough between colors to affect sheet dimensions or sheet distortion.

The Lithographic Technical Foundation recommends 76 to 80 F dry-bulb temperature and 43 to 47 percent relative humidity as the ideal conditions in a lithographic press room with the relative humidity controlled within plus or minus 2 percent and the dry-bulb temperature within plus or minus 2 F.[3] The result of variations in relative humidity on register may be estimated for offset paper from the data in Figs. 1 and 2. Closer control of the relative humidity of the press room air is required for multicolor printing of 76 in. sheets as compared with 22 in. sheets for same register accuracy. Closer control is required for multicolor printing where the sheet makes two or more trips through the press as compared to one color printing. Many plants maintain a dry-bulb temperature of 80 F during the cooling season and 76 F dry-bulb temperature during the heating season. Comfort conditions and economy of operation are the factors influencing the choice of temperature.

The drying of ink is affected by temperature and humidity so that uniformity of results and standardization of procedures are difficult to obtain without control of the atmospheric conditions. Printing inks must dry rapidly to prevent offsetting and smearing. High relative humidity and high moisture content of the paper tend to prevent ink penetration, and more ink remains on the surface than can quickly be oxidized. This affects the drying time, intensity of colors, and the uniformity of the ink on the surface. Temperatures of 75 to 80 F and a relative humidity below 60 percent are favorable for drying.

AIR CONDITIONING THE MULTICOLOR OFFSET LITHOGRAPHY PLANT

The air-conditioning system for the press room of a lithographic plant should provide independent control of the temperature and relative humidity of the air, filter the air, supply ventilation air, and distribute the air without pronounced air movement around the presses. The control of relative humidity is the most important requirement. The use of anti-offset sprays to set the ink will create an additional air filtering load from the press room air. Drafts or high air flow over the press will result in excessive drying of the ink and water which may cause operation troubles due to scumming.

The operating procedures of the press room should be analyzed while determining the heat removal load. The lighting load is high due to the type of work and is constant throughout the day. The temperature of the paper brought into the press room and the length of time it is in the room should be considered to determine the sensible load from the paper. Fig. 4 shows the hours required for wrapped paper to reach room temperature.[3] The motors operating the presses usually constitute a large portion of the internal sensible heat gain. Readings should be taken to obtain the running power load of the larger multicolor presses. The moisture content of the paper fed to the press and the relative humidity of the atmosphere must be considered in computing the internal latent heat gain. The printer usually specifies paper that is in equilibrium with air at a relative humidity somewhat higher than the press room condition. This means the paper will give up moisture to the space as it absorbs moisture from the press. If the moisture transfer is in balance, the water used in the printing process would be included in the internal moisture load. It is preferable to determine the water evaporation from the presses by test.

Refrigeration with provision for separate relative humidity control, or else liquid absorption or solid adsorption dehumidifying equipment for independent control of the relative humidity plus provision for cooling, will meet the requirements of precise multicolor offset lithography printing. The need for individual control of relative humidity in the press room may be determined by calculating the dimensional change of the paper for each percent change in relative humidity and checking this with the required register for the printing process. The data in Fig. 2 is for a composite lithographic paper. Air conditioning of the photographic area, stripping room, and platemaking area of offset lithography plants as well as the press room is important. The photographic department air conditioning is usually considered next in importance to the press room. Most of the work in