offset lithography is done on film. Air conditioning provides control of cleanliness and comfort, and holds the size of the film on register work. The higher quality of work and greater accuracy in this department will carry over into other departments.

Air conditioning is important in the stripping department for both comfort and for maintaining size and register. Curling of the film and flats, and shrinkage or stretch of materials can be minimized by maintaining constant relative humidity. This is particularly important when working on close register color work. Platemaking, including lithographic plates, is covered in a later section. The photographic area, stripping room, and platemaking area are usually maintained at the same conditions as the press room. The optimum relative humidity in the platemaking department is 45 percent or lower. This moisture control of the air will result in less exposure compensation, a more consistently operating plate, and a longer useful life of the bichromated colloid coatings. The exposed water surfaces in the photographic and plate making area, and the water sprays in the platemaking room, are sources of internal latent heat gain. The exhaust air requirements of the platemaking room should be checked.

COLLOTYPE PRINTING

Collotype or photo-gelatin printing is a sheet-fed printing process related to lithography. The printing surface is bichromated gelatin with varying affinity for ink and moisture depending on the degree of light exposure received. There is no mechanical dampening as in lithography, and the necessary moisture in the gelatin printing surface is maintained by operating the press in an atmosphere of high relative humidity, usually about 85 percent. Since the tone values printed are very sensitive to changes in moisture content of the gelatin, relative humidity should be maintained within 2 percent. Temperature must also be closely maintained since tone values are very sensitive to changes in ink viscosity. A temperature of 80 F plus or minus 3 F deg is recommended. Collotype presses are usually partitioned off from the main plant, which is not air conditioned or is maintained at a lower relative humidity; and the paper is exposed to the high relative humidity only while it is being printed.

SHEET-FED RELIEF PRINTING

In sheet-fed relief printing processes the paper should be protected from variations and extremes in humidity and temperature to prevent wavy edges, curling, and buckling so that it will feed properly and stay flat. Expansion and contraction are not so important except as the cause of distortion. 50 percent relative humidity in the press room with the dry-bulb temperature selected for comfort represents good practice. The control is not as critical as for offset and gravure processes.

SHEET-FED GRAVURE

Expansion, contraction, and distortion is sheet-fed gravure printing, as in offset printing, should be prevented due to the importance of correct register. However, the paper need not be in equilibrium with air at a relative humidity higher than that of the press room because no moisture is added to the paper in the printing process. The humidity and temperature control is exacting, as in offset printing. The relative humidity should be controlled within 2 percent, and the temperature within 2 F deg. Considering the paper, rolls, ink, and prevention of static electricity, a relative humidity of 45 to 50 percent, with the temperature selected for comfort, represents good practice.

PLATEMAKING

Humidity and temperature control are important in the departments making lithographic and collotype plates, photo-engravings, and gravure plates and cylinders. The moisture content and temperature of the plates affect the sensitivity of the coating. The coatings increase in light sensitivity with increasing relative humidity and temperature which requires corresponding adjustments in light exposure to give uniform results.

Maintaining a constant dry-bulb temperature and relative humidity in the platemaking rooms provides a plate at a known control point. The operator then knows how the plate will react to a given amount of exposure to light. A bichromated colloid coating starts to age and harden as soon as it is dry. This action will vary with the atmosphere so that exposures made a few hours apart may be quite different. This rate of reaction can be estimated more closely when the space is air conditioned. This permits reducing the exposures progressively in order to maintain uniformity. The optimum relative humidity is 45 percent or less. Data indicate that this condition will substantially increase the useful life of bichromated colloid coatings. A dry-bulb temperature of 75 to 80 F maintained within 2 F deg represents good practice. The relative humidity control should be within 2 percent. The ventilation air requirements of the plate room should be investigated. In a plant with a large production of deep-etch plates, consideration should be given to locating this operation outside the conditioned area.

WEB PRINTING

Air conditioning in the press room of newspapers and other web letterpress printing processes minimizes problems due to static electricity, ink mist, and expansion or contraction of the paper during printing. Static charge is a major cause of breaks in the continuous roll of paper. A low relative humidity will also cause the paper to lose moisture from the ends of the rolls and contract. This contraction at the edge of the paper tends to cause edge crack which can result in breaking of the web on the press. The relative humidity in the press room should be in balance with the moisture content of the paper. A relative humidity of 50 percent with the temperature selected for comfort is good practice.

In web offset and gravure printing, the control of the air conditions is more exacting. The relative humidity in the press room should be in moisture equilibrium with the paper. As in other web printing, 50 percent relative humidity within 2 percent and the temperature selected for comfort is recommended.

AIR CONDITIONING THE WEB PRESS ROOM

Air conditioning a web press room is highly specialized. The operating procedures of the press room should be studied to arrive at an economical application of the air-conditioning equipment. The large motors operating the presses are the largest source of internal sensible heat gain. Readings should be taken to determine the starting power load and the running power load of the presses. The frequency of operation, the average maximum press running time per run, percentage of operating time, and time of day the press is operated should be considered in order to determine the load factor to apply to the motor name plate in calculating the heat from the press motors.

Newspaper presses are operated intermittently with the running time varying with the size of the edition. With the driving motor located in the reel room, the motor inefficiency and the motor load used to drive the reels should be deducted from the press room load and added to the reel room internal sensible heat load. The average temperature of the press will rise during operation so that this portion of the motor load is not instantaneous. This may be considered in computing the press motor load factor if the press is operated intermittently and the air conditioning is operated continuously. Study of the press operating cycle and measurement of the press temperatures for the design operating cycle are necessary to determine the allowance for temperature rise of the press for an intermittent operation. The paper is heated as it passes through the press. If the paper is at the press room temperature or lower, the heat due to the difference in temperature between the paper when it is removed from the press room and when it enters the press may be deducted from the press room motor load.

The ink mist in web press rooms requires ventilation. Any recirculated air should be adequately filtered to prevent clogging of the cooling coils and to maintain a low concentration of ink mist in the space. The exhaust air system should be located so that most of the ink mist is removed and not permitted to diffuse through the room.

Air conditioning in the composing and engraving rooms is important for human comfort. The high concentration of people in these rooms combined with a high lighting load and heat producing equipment results in high internal loads. The linotype machines are fitted with gas or electrically heated lead melting pots, and the excess heat must be carried off to make working conditions suitable. The heat load and exhaust air requirements of the machines should be checked with the machine manufacturer.

CONTROL OF PAPER

Control of the moisture content and temperature of the paper is most important in multicolor lithography but is important in all types of printing. Paper should be received at the printing plant protected with moisture-proof wrappers. The wrappers should not be removed or broken until the paper is brought to the press room temperature. Exposed paper at temperatures substantially below the room temperature will rapidly absorb moisture from the air with resulting distortion. Fig. 4 shows the time required to temperature-condition wrapped paper. Paper is usually ordered by the printer at a moisture content approximately in equilibrium with the relative humidity maintained in the press room. The paper makers find it difficult to supply paper in balance with a relative humidity higher than 50 percent.[2]

The sword hygrometer, or the paper hygroscope, developed by the Lithographic Technical Foundation, is an indispensable tool for checking the hygroscopic condition of paper relative to the surrounding air. Knowledge of this relationship is essential at every step in printing paper in sheet form. The instrument resembles a sword in shape, and the blade contains a moisture-sensitive element. Expansion or contraction of the element actuates the pointer in a dial mounted on the handle. In use, the instrument is waved in the adjacent air until the pointer comes to rest and the dial is set to give a zero reading. The sword is then inserted into the paper and the movement of the pointer from the zero reference mark indicates the moisture condition relative to surrounding air.

Fig. 5 illustrates sword readings taken on three piles of paper in a pressroom. The first indicates that the paper is far too dry to be exposed to the room atmosphere without the formation of wavy edges. The second reading indicates that this paper is in equilibrium with the air which is correct for all sheet-fed printing except multicolor lithography. The third was taken on paper that was *wet* relative to the press room air. This pile had been conditioned to equilibrium with the air in the paper stock room where the relative humidity was 7

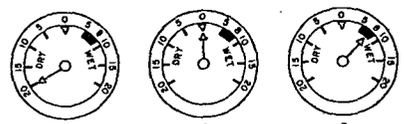

Fig. 5 .... Sword Hygroscope Readings Taken from Three Lots of Paper

percent above that in the press room, where the reading was taken and, therefore, was in optimum condition for multicolor lithographic printing.

AIR-CONDITIONING SYSTEMS

To meet the requirements of multicolor offset lithography printing, air-conditioning systems should provide separate control of relative humidity independent of temperature. Liquid absorption or solid adsorption dehumidifiers also can be used for independent control of relative humidity plus provision for temperature control. Either central systems or unitary equipment may be used, depending on the size and requirements of the printing plant.

For further information on central systems see Chapter 1. Unitary equipment is discussed in Chapter 57 of the 1961 GUIDE AND DATA BOOK. Sorption dehumidifiers are discussed in Chapter 21 of the 1961 GUIDE AND DATA BOOK and in Chapter 78 of this volume.

REFERENCES

[1] C. G. Weber and L. W. Snyder: Reactions of lithographic papers to variations in humidity and temperature (*Journal of Research, National Bureau of Standards*, Vol. 12, January 1934).

[2] R. F. Reed: *What the Lithographer Should Know About Paper* (Lithographic Technical Foundation, Inc., *Technical Bulletin* No. 8, New York, 1959).

BIBLIOGRAPHY

K. D. Robinson: *What the Lithographer Should Know About Air Conditioning* (Lithographic Technical Foundation, Inc., *Bulletin* No. 309, New York, 1950).

R. S. Arnold: Air conditioning printing plants (*Air Conditioning, Heating and Ventilating*, August 1959).

W. C. Dahl: Effect of atmospheric humidity on paper and printing (*Paper Trade Journal*, June 29, 1939).

Douglas Jones: Effect of atmospheric humidity on newsprint (*Paper Trade Journal*, August 1, 1940).

W. H. Junker: Air conditioning solves printing problems (*Heating, Piping and Air Conditioning*, February 1956).

C. W. Latham: Air conditioning, humidification, dehumidification for better quality control (*American Printer and Lithographer*, May 1956).

C. W. Latham: How air conditioning aids printers (*Inland and American Printer and Lithographer*, May 1959).

A. C. Poulter: Rate of change in moisture content of paper (*Patra Journal*, Vol. 5, No. 5, March 1942).