where

OC = operation cost, dollars per 1000 car-miles.
D = average drawbar horsepower demand on a locomotive at speed S.
E = cost per horsepower-hour, dollars.
F = additional necessities such as ice, steam or propane, pounds per hour
G = cost of additional necessities, dollars per pound.
H = drawbar horsepower required when system is not operating.
S = speed of train operation, miles per hour.
K = length of cooling season, months.
0.56 = Proportion of operation time to total time during the cooling season.

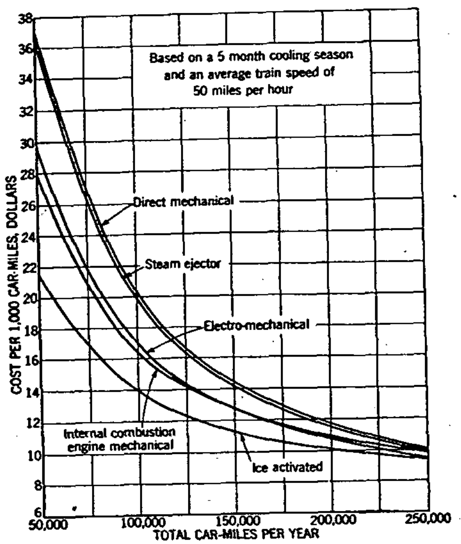

FIG. 3. COMPARATIVE TOTAL COSTS FOR RAILWAY PASSENGER CARS

Total Cost of Air Conditioning

When the fixed charges, maintenance cost, and operation cost are each expressed in terms of 1000 car-miles, addition of the three elements will give the total cost of air conditioning on that basis.

Comparisons of the total cost per 1000 car-miles for the five methods of air conditioning are shown in Fig. 3, representing costs for an average condition, namely, a cooling season of five months and an average speed of 50 mph.

REFERENCES

Summary Report on Air Conditioning of Railroad Passenger Cars, by Division of Equipment Research, *Association of American Railroads*, November 24, 1936.

Engineering Report on Air Conditioning of Railroad Passenger Cars, by Division of Equipment Research, *Association of American Railroads*, April 15, 1937.

Report on Performance and Cost of Operation of 1937 Internal Combustion Engine Mechanical Compression Equipment for Air Conditioning Railroad Passenger Cars, by Division of Equipment Research, *Association of American Railroads*, May 1, 1937.

Chapter 34

INDUSTRIAL AIR CONDITIONING

Atmospheric Conditions Required, General Requirements, Classification of Problems, Control of Regain, Moisture Content and Regain, Conditioning and Drying, Control of Rate of Chemical Reaction, Control of Rate of Biochemical Reactions, Control Rate of Crystallization

IN the application of air conditioning to industrial processes, too much stress cannot be laid upon a thorough understanding by the air conditioning engineer of the problems involved. A complete knowledge of these problems is necessary before a satisfactory design can be made.

Individual processes and machines are changing rapidly and air conditions must be constantly revised to meet the new conditions.

ATMOSPHERIC CONDITIONS REQUIRED

The most desirable relative humidity during processing depends upon the product and the nature of the process. As far as the behavior of the material itself and its desired final condition are concerned, each material and process presents a different problem. The best relative humidity may range up to 100 per cent. Similarly the most desirable temperature may range between wide limits for different materials and treatments. Extremes in either relative humidity or temperature require relatively expensive equipment for maintaining these conditions automatically. In departments where people are working, their health, comfort, and productive efficiency must be considered and often a compromise between the optimum conditions for processing and those required for the comfort of the worker is desirable.

It is generally considered that relative humidities below 40 per cent are on the dry side, conducive to low regains, a brittle condition of fibrous materials, prevalence of static electricity, and a tendency toward dryness of the skin and membranes of human beings. At the other end of the scale, humidities above 80 per cent are relatively damp, conducive to high regains, extreme softness, and pliability.

Table 1 lists desirable temperatures and humidities for industrial processing. In using this table, care must be taken in qualifying the process. In preparing many materials, conditions are not maintained constantly, but different temperatures and humidities are held for varying lengths of time.