ing of the three types. This bears out the popular preference of trapezoidal slots. In either capacity or flexibility trapezoidal slots are better than rectangular slots. This is in disagreement with Bolles' study based upon Rogers-Thiele equations which indicated that the cap with rectangular slots would provide the greatest capacity at maximum slot opening.

It is to be noted that triangular slots are not as undesirable as the Rogers-Thiele equations would show. The maximum capacity of the cap with triangular slots is actually not much lower than that of rectangular or even trapezoidal slots. On the other hand if a column is to be designed to meet the widest range of operation in throughput, caps with triangular slots actually are the best choice and the most stable of the three types (when one assumes a minimum stable slot opening of 0.5 in.). Caps with triangular slots probably can be operated at a throughput of 9.8% of maximum capacity, while caps with rectangular slots probably cannot be operated satisfactorily under 25% of maximum capacity. Since the maximum slot capacity of cap with triangular slots is actually as high as 85 and 93% of the maximum capacity of caps with trapezoidal and rectangular slots respectively, it properly deserves more attention in future applications.

can be used in general for all types of slots.

CONCLUSION

Slot capacities of trapezoidal and triangular slots in a bubble cap column calculated by Rogers-Thiele equations are underestimated by 14.3 and 50.0%, respectively.

The correct equations given in this paper show that:

1. Caps with trapezoidal slots are better than caps with rectangular slots in either capacity or flexibility.
2. Caps with trapezoidal slots are the best for distillation columns of high vapor/liquid ratios, and caps with triangular slots the best for columns of low vapor/liquid ratios.
3. Triangular slots provide the highest flexibility. Although the maximum capacity of caps with triangular slots is somewhat lower than that of caps with the other two types of slots, it is much higher than indicated by Rogers-Thiele equation; therefore it deserves more attention in the future, especially for distillation and absorption columns with high liquid loadings or widely variable vapor loadings. These occur for instance in batch columns in which fine chemicals in small quantities are produced and in which products are often switched from one to another.

Slot of 4-in. cap	Maximum capacity/cap		Minimum capacity/cap	
	cfs	% trapezoidal	cfs	% maximum
Triangular	.765	84.5	.075	9.80
Trapezoidal (R_s = 0.5)	.905	100	.176	19.46
Rectangular	.825	91.2	.208	25.2

DISCUSSION

Huitt and Huntington (*3*) compared their observed slot openings of a rectangular slot with their equation and also with Rogers-Thiele equation. Figure 3 shows that both equations agree with their data fairly well. However vapor loads predicted by the Huitt-Huntington equation are about 20% higher than their observed values, except when the slot is fully open. Rogers-Thiele equation is on the conservative side when the slot is more than 60% open. Therefore the latter equation is preferable in design calculations to the first. In this comparison a slot orifice coefficient of 0.51 was used. This confirms that 0.51 is a proper and conservative coefficient for rectangular slots.

Simkin *et al.* (*4*) used the Rogers-Thiele equation with the coefficient modified to fit the experimental data of Griswold (*5*) for trapezoidal slots. They proposed to use 0.70 in Rogers-Thiele equation instead of 0.51 for trapezoidal slots. This bears out the finding of this paper that Rogers-Thiele equation for trapezoidal slots is about 14% too low. Therefore if equations in this paper are used in design, the same coefficient of 0.51

NOTATION

A = slot area, sq. ft.
A_s = total slot area per tray, sq. ft.
g = acceleration of gravity, 32.2 ft./sec./sec.
h = slot opening variable, in.
h_s = slot opening, in.
H_s = slot height, in.
K_s = slot orifice coefficient
N_c = number of caps per tray
N_s = number of slots per cap
R_s = trapezoidal slot shape factor, w_{st}/w_{sb}
u = vapor velocity through an element of slot area, ft./sec.
V = total vapor load per tray, cu. ft./sec.
V_m = maximum vapor load per tray, cu. ft./sec.
V_{mR} = Maximum vapor load per tray calculated from Rogers and Thiele's equation, cu. ft./sec.
V_{mT} = maximum vapor load per tray, calculated from the author's equation, cu. ft./sec.
V_s = vapor load per slot, cu. ft./sec.
w = slot width, in.
w_{sb} = slot width at bottom, in.
w_{st} = slot width at top, in.
ρ_L = liquid density, lb./cu. ft.
ρ_V = vapor density, lb./cu. ft.

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BOOKS

Management for Engineers, Roger C. Heimer. McGraw-Hill Book Company, Inc., New York (1958). 453 pages. $6.75.

The purpose of this textbook is to acquaint "the young engineer with the business firm's decision-making process." It is written with the premise that the reader has little knowledge of the workings of a business firm.

For the novice in the business world Chapter 2, "The Legal Forms of Business Organization," and Chapter 3, which analyzes the finances of a mythical business firm, should be particularly helpful. The major portion of the book is concerned with daily operational problems: profit, cost, interest, depreciation, insurance, and inventory.

A basic understanding of organizational structure and operation will be gleaned from the last four chapters, which deal with over-all managerial problems, and really differentiate this book from the usual economics textbook. The young engineer should find these chapters most helpful in understanding managerial decisions.

The best use of this book would be as a supplement to the usual undergraduate economics course.

J. M. Ruder

Engineering Materials Handbook. Charles L. Mantell, Editor. McGraw-Hill Book Company, Inc., New York (1957). 1936 pages. $21.50.

The field of engineering materials is a broad one, and it seems almost impossible that any one book could cover the whole subject completely. The "Engineering Materials Handbook" does, however, cover the field with a remarkable degree of completeness, especially in the field of metallic materials.

In forty-three well-organized sections, metals, organic and inorganic materials, and the cause and prevention of failures in materials are treated. To make specific data readily available, technical tables, design information, structural characteristics, and tabular data have been carefully prepared, and the references at the end of each section enable the reader to find any information not embraced in the handbook. The reliability of the information presented is achieved by coordinating the work of more than 150 specialists under the direction of Professor Mantell who is chairman of the Department of Chemical Engineering at the Newark College of Engineering.

To make the book of practical value to an engineer concerned with materials, emphasis is placed on the fabricated forms of materials, their physical and mechanical properties, their advantages, limitations, competition with one another, protection against deterioration, and their ability to withstand use and abuse.

Approximately half of the book concerns metals, and the reviewer feels that the properties of the individual metals are thoroughly covered. The section on steel and its heat treatment is especially well done. However, it is the reviewer's opinion that too little space is given to the difficulties that arise in the fabrication of materials into commercial shapes.

It is in the second half of the book that the reviewer has the idea that the editor has spread himself too thin in a desire to take in the whole field of materials. In devoting reasonably complete attention to such materials as brick, clay, textiles, stone, and concrete, the editor has not allowed enough space for complete coverage to such newer subjects as materials for nuclear reactors, rockets, and guided missiles. While textiles, stone, etc., are of interest to some engineers, it is the reviewer's opinion that chemical and metallurgical engineers would have profited more had the treatment of the newer materials, such as high temperature ceramics, been more inclusive.

Nevertheless, the reviewer feels that the handbook is a good one and would be of practical value to any engineer faced with a problem of the choice of materials, particularly if the choice is to be made in the metallic field.

A. S. Tetelman
Yale University

Modern Mathematics for the Engineer, E. F. Beckenbach, et al, University of California Engineering Extension Series, McGraw-Hill Book Company, Inc., New York (1958). 514 pages. $7.50.

This book is described as a broad survey of the applications of advanced mathematics to the expanding modern technology. The basic idea behind the volume is quite sound; indeed, an intimate association with a large number of the theories of advanced mathematics has become a practical necessity for those attempting to keep abreast of the literature in practically any scientific field.

Modern Mathematics for the Engineer is