The Hemmi 405 Cement Composition Slide Rule

Cliff Frohlich

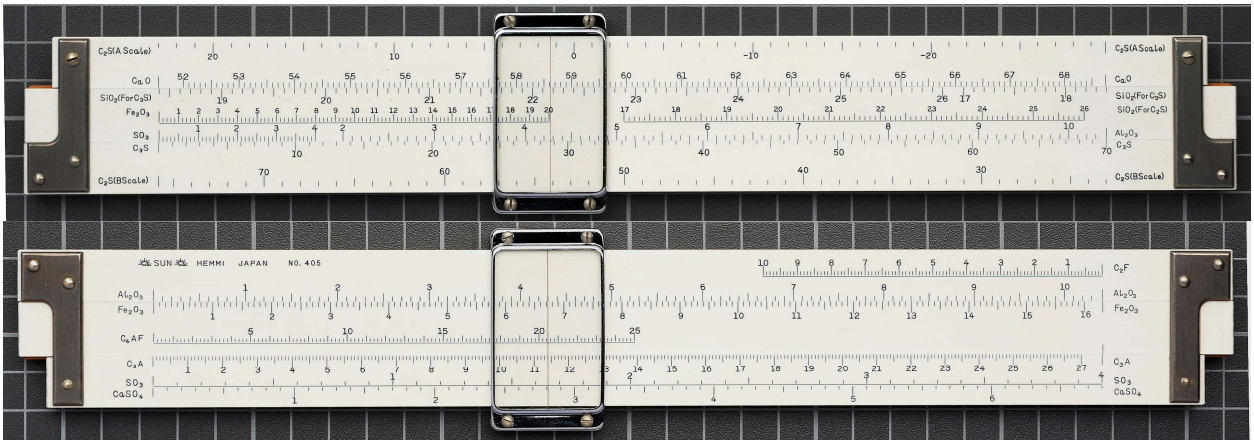

FIGURE 1. The Hemmi 405 Cement Slide Rule. Front (top) and Reverse (bottom)

Introduction

The Hemmi 405 slide rule is a special-purpose bamboo slide rule sold by Hemmi between at least 1954 and 1968.[1] It is somewhat rare, and was assigned a 'RRR' rarity rating in the van Herwijnen system (https://www.sliderulemuseum.com/Rarities.htm). A notable feature of the Hemmi 405 is that the B, C, and L scales are absent; thus, the rule cannot perform ordinary calculations involving multiplication, division, or logarithms. The rule's only practical use is to help make decisions about proportions of ingredients in recipes for Portland cement.

Few Oughtred Society members are cement chemists; the purpose of this article is to provide background information so non-specialist readers can understand generally how the Hemmi 405 works and why it is helpful for manufacturing cement. This article provides information augmenting the rather cryptically written users' manual[2] published as a technical report by the Portland Cement Association (PCA). Surprisingly, the PCA manual does not list the equations that the rule is designed to solve or explain why the rule's design works for solving them. However, this article will not replace the PCA manual for readers interested in cement manufacture.[3]

Following this introduction, the second section of this article will discuss the historical background of the Hemmi 405 rule and present a brief description of how it calculates proportions of cement constituents. This section will also explain the possibly-confusing labeling of its scales, whereby some scales are labeled with the conventional notation for chemical compounds learned by many of us in introductory chemistry, and other scales are instead labeled using a specialized abbreviated notation called Cement Chemistry Notation (CCN; see Table 1). The third section of this article will present some basic information concerning Portland cement and its history. The fourth section will explain the theoretical basis for how the slide rule works. The final section of this article will discuss some limitations of the design of the Hemmi 405.

The Hemmi 405 Slide Rule: History and Basic Operation

The PCA users' manual for the Hemmi 405 slide rule[2] mentions that it is based on a 1929 design by L. A. Dahl[4]. The PCA manual presents no general background information about cement. It states only that

> The slide rule… was designed for converting percentages of the major oxides in Portland cement and cement clinker into percentages present in the compounds present in the clinker at crystalline equilibrium,

and refers the reader to articles by R. H. Bogue[5,6] concerning calculation of proportions of compounds