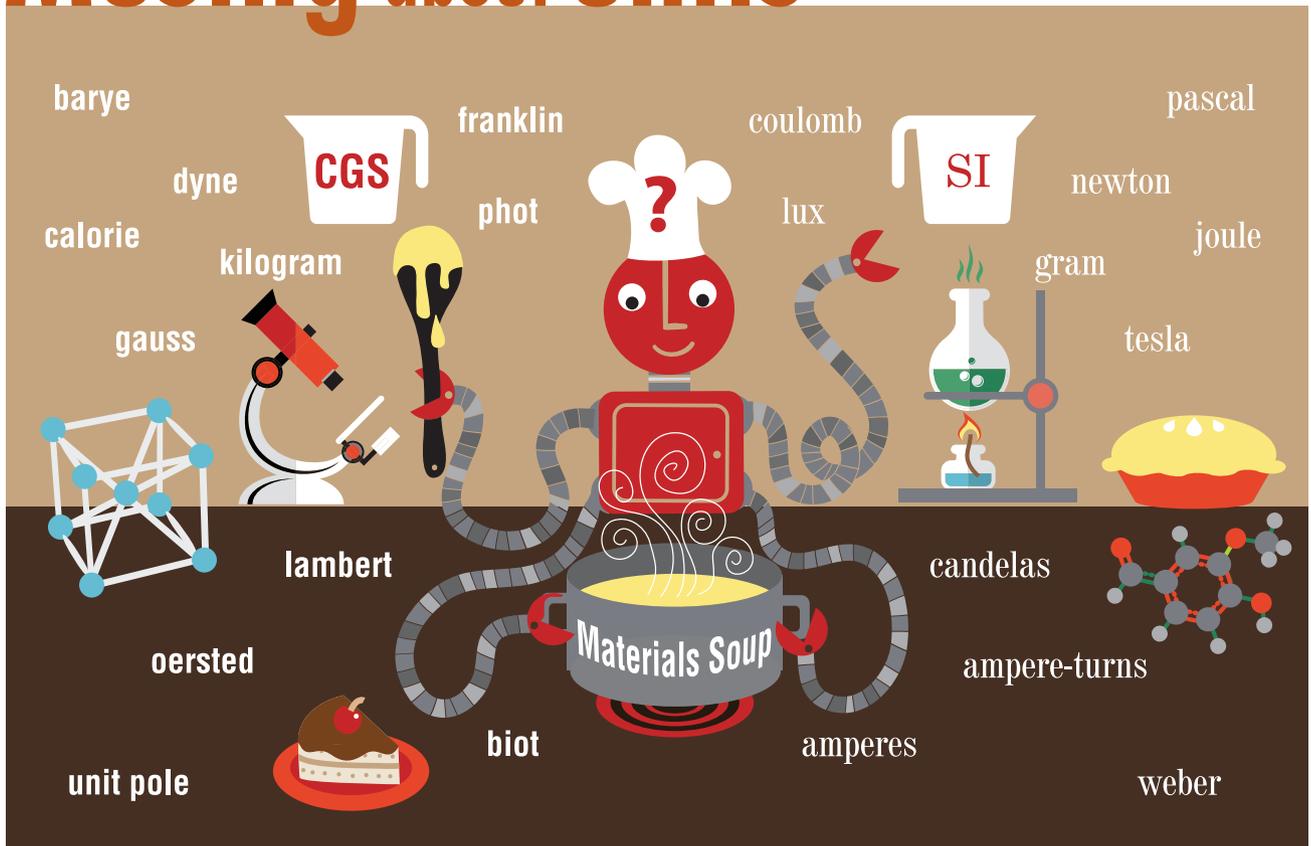


Musing about units



As materials researchers, all of us (whether we're materials scientists, physicists, chemists, biologists, geologists, engineers, or other) very quickly learn the importance of units. Many introductory textbooks have special sections or chapters discussing units and how to use them. The world standard now is SI units¹ (otherwise known as mks units), but for most of us our choice of units (including cgs units) is probably based upon whether or not the units seem natural for the problem that we're working. For me, it seems more natural to use mks units for some problems, cgs units for other problems, and use other units as needed.

So I reacted rather badly when I received a request from a colleague the other day who wanted a group of us who are working on various aspects of a complex problem to provide all of our results in cgs units. I responded by

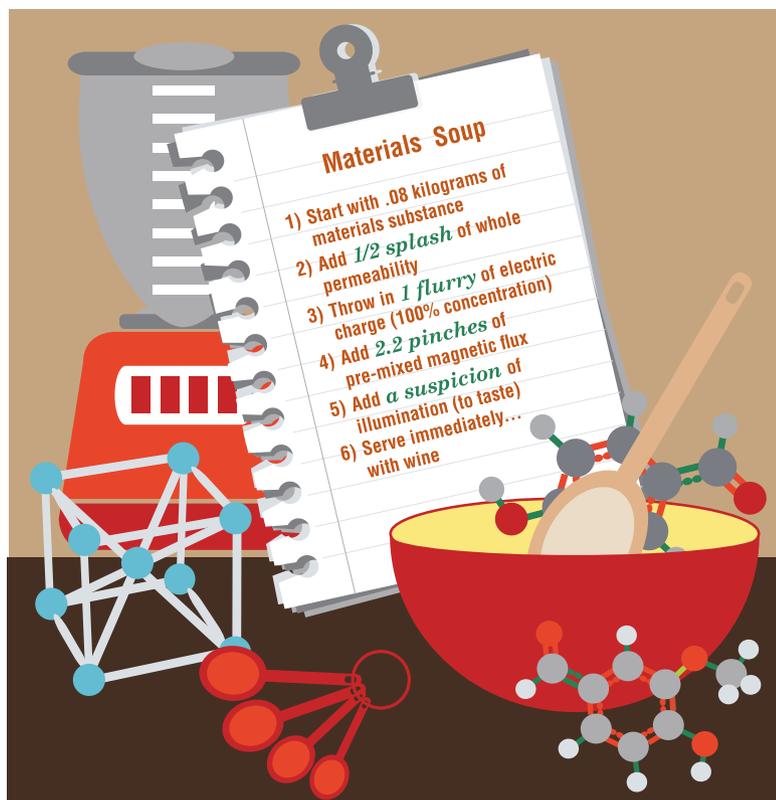
sending out the following intemperate email message:

"Cgs units?!! Cgs units?!! You guys are killing me! What is this cgs nonsense? Hasn't the entire world settled on SI units, i.e., mks for old-timers like me? Do any reputable people use cgs units? Isn't this anathema—blasphemy of the highest order? Won't we be reviled in the bastions of science? Won't there be newspaper, radio, and tv reporters camped at our doorstep? Won't our role as the guardian of public virtue be debated in the halls of Congress? Won't we find protesters howling in the streets about our lack of conformity to the norms of civilized society? I call for a vote! Nay, I demand my day in court! If we allow you to force us to use cgs units today, tomorrow you'll take our lunch money, and then you'll force us to wear white dress

shirts and even (Gasp!) neckties. You'll have to pry my mks units from my cold dead hands! I'd sooner eat turnips!"

[Note: I do apologize to those of you who like white dress shirts and turnips, but I loathe neckties and am unrepentant in my distaste for them.]

This started me thinking about our confusing approach to units and the inconsistencies surrounding our use of them. Notwithstanding the fact that most of us probably use the units most appropriate for the problem at hand, I know that there are communities that prefer a select set of units for a given field. Some of this may be because those involved feel that they understand science or engineering analysis better when framed in one set of units than another. Some of this may be due to their teachers, who chose particular sets of units. An example of this involves the classic (pun fully intended) text on



electrodynamics by John D. Jackson,² which uses electrostatic units. Over the years, I've been around numerous debates involving defenders of Jackson's excellent text as well as those who don't like it because of the use of electrostatic units. I remember other debates about which units are best for nonlinear optics as well as other more esoteric subjects, although I must admit that those debates were so long ago that I've forgotten the basis for any claims that were made by the disputants.

Although the US Congress enacted a law in 1866 making it lawful to employ metric units in weights and measures,³ and in 1893 the US government decided that the meter and the kilogram would be the standards for length and weight,⁴ we've only half-heartedly accepted the metric system. Most of the world has adopted the metric system, but I read recently that only Myanmar, Liberia, and the United States have not accepted the metric system.⁵ In the USA, our speedometers now typically show speed in both miles/hour and km/hour, with the former typically more prominently displayed. Some highway signs report

distances in both miles and kilometers, but some only in miles. We still measure weight in pounds. As scientists and engineers, this should offend us. I note, however, that those of us who are gravity-challenged should prefer our weight in pounds, if only because the numbers are smaller than in Newtons. {In my defense at this breach of my premise, I offer this partial quote from Emerson, "A foolish consistency is the hobgoblin of little minds...."⁶} However, if you've recently had your weight measured on an electronic scale, you know that the scale offers your weight in pounds or in kilograms. It's enough to make a mature researcher want to howl at the moon or consume vast quantities of alcoholic beverages.

Beyond this, there are areas of human endeavor wherein no one or at least very few even pretend to understand the meanings of the units involved. My favorite example is cooking wherein no one but hardcore foodies have this special knowledge. What is a dash, a pinch, a hint, a soupcon, a suspicion, a trace, a flurry, a splash, or a drop? I can sort of understand the idea of a tablespoon as a unit of measure, but then I have three

different sizes of tablespoons in my kitchen silverware drawer. Not only that, but is a tablespoon what I have when I've filled the spoon part level with the edges of the spoon, or is it a heaping tablespoon that includes the maximum that can be carried by the spoon? Or is it some measure in between?

We have an opportunity here to carry materials research to the next realm by imposing order on this manifest display of anarchy by the foodies. I look forward to the day when everyone understands the relationship between drops and splashes in well-defined units of volume. Dashes, hints, pinches, traces, suspicions, soupcons, and flurries should all be well-defined units of mass. No more of this chaotic behavior with cooks adding flavorings "to taste" with little or no knowledge of the concentrations of the ingredients in their dishes.

Materials research should rule the kitchen. Think of the opportunities for entrepreneurs, who can now develop businesses based upon sales of measuring implements to ensure accurate metrology for all of these units. I see research projects, funding opportunities, new journals, new conferences, patents, and new businesses flourishing as a result of this endeavor. New faculty positions will emerge as Escoffier, Le Cordon Bleu, and others establish departments of materials research to burnish their reputations amongst the cognoscenti. Imagine how MRS Meetings would spice up the exhibit hall and the poster sessions as Master Chef-Researchers demonstrated the scientific basis of their latest dishes! A marvelous future awaits us if we will only seize the moment.

Steve Moss

References

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