Open forum

FIELD SYNERGY NUMBER VERSUS STANTON NUMBER

by

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In this study, a look on field synergy number is presented. The field synergy number was introduced in literature in 21st century by Professor Zeng-Yuan Guo and co-workers. It is defined as the ratio of the Nusselt number to product of Reynolds and Prandtl numbers. As a result, the field synergy number is defined in the same way like the Stanton number although the Stanton number was named after Thomas Edward Stanton (1865-1931). Based on this study, it is clear that existing dimensionless number in literature i. e. Stanton number can be used instead of the field synergy number because there is no need to change the name of the Stanton number to the field synergy number. As well as the Stanton number can be also used in mass transfer applications.

Key words: *field synergy number, Stanton number*

Introduction

Dimensionless groups are useful in arriving at key basic relations among system variables that are valid for various fluids under various operating conditions [1]. One of these dimensionless groups, which can be used in heat and mass transfer applications is the Stanton number. The Stanton number is named after Thomas Edward Stanton (1865-1931). It is used to characterize forced convection heat transfer and represents the ratio of heat transferred into a fluid to the thermal capacity of fluid:

$$\mathrm{St} = \frac{h}{GC_p} = \frac{h}{\rho U C_p} \tag{1}$$

In literature, it is well known that some dimensionless numbers can be expressed by using a combination of the other dimensionless numbers [2, 3]. Using the same technique, the Stanton number can be expressed by using a combination of the Nusselt number, Reynolds number, and Prandtl number as:

$$\mathrm{St} = \frac{\mathrm{Nu}}{\mathrm{Re\,Pr}} \tag{2}$$

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It is well known that the Sherwood number is the mass transfer analog of the Nusselt number while the Schmidt number is the mass transfer analog of the Prandtl number. Therefore, eq. (2) can be written for mass transfer applications as:

$$\mathrm{St} = \frac{\mathrm{Sh}}{\mathrm{Re\,Sc}} \tag{3}$$

The Stanton number definition in eq. (3) is useful and needed for diffusion of mass (mass diffusion).

On the other hand, the field synergy number (Fc) was introduced in literature in 21st century by Professor Zeng-Yuan Guo and co-workers. It is defined as the ratio of the Nusselt number to product of Reynolds and Prandtl numbers:

$$\mathrm{Fc} = \frac{\mathrm{Nu}}{\mathrm{Re\,Pr}} \tag{4}$$

If the readers have a look on the field synergy number, eq. (4), the readers can notice that Guo *et al*. [4] renamed the Stanton number using a new name, the field synergy number. Later, the field synergy number was used in other publications such as ref. [5].

According author's opinion, there is no need to change the name of the Stanton number to the field synergy number. Moreover, the Stanton number has the following advantage over the field synergy number since it can be used in mass transfer applications as shown in eq. (3).

In order to encourage newcomers to study the subject of heat and mass transfer, we need to confront them with fewer dimensionless numbers, not more.

For example, if anyone is trying to learn about solution methods for linear equations; to understand the literature he must grapple with Kryllov sub-spaces, Schur eigenvalue forms, Jordan structures, Hessenberg systems, Hermitian matrices, the Arnoldi process, the Householder reduction, and more. This may be convenient shorthand for the insiders; but it assists his memory not at all. It will take him years to enter their club.

What good fortune that at least Thomas's procedure is more often referred to as the tri-diagonal-matrix algorithm, and shortened to TDMA! Its deviser is forgotten; but his device lives on.

Besides, to have a dimensionless number named after someone or introduced by someone is no guarantee of remembrance. Thus Max Jakob [6], in a footnote on page 487 of his book *Heat Transfer*, Vol. 1, when introducing the free convection number (later abbreviated as FCN?) wrote: *The present author does not know why Groeber suggested the name Grashof for this dimensionless group. The other names used to characterize dimensionless groups are chosen to honor men who have had merit in the development of fluid mechanics and heat transmission*.

The present study of field synergy number *vs*. Stanton number shows that field synergy number is not original: it is a repeat of the Stanton number. Those who might think that the similarities between field synergy number and Stanton number are purely coincidental should take note of the following pattern.

The lead author of the field synergy number (Professor Zeng-Yuan Guo) has used the same publishing technique many times since, and every time he was exposed on the basis of stringent anonymous peer review. For more details, the readers can see Conclusion of ref. [7].

At the end, author of present note wants to point out how ideas spread [8], but sometime new names are given to mask their pedigree, and depends on the power of members of national academies [9].

Indeed, it is becoming a lot easier to take an existing dimensionless number like the Stanton number, change it to the field synergy number, and publish the idea as novel.

Nomenclature

C_p – specific heat, [$Jkg^{-1}K^{-1}$]
Fc – field synergy number, [–]
G – mass flux, [$kgm^{-2}s^{-1}$]
h – heat transfer coefficient, [$Wm^{-2}K^{-1}$]
Nu – Nusselt number, [–]
Pr – Prandtl number, [–]
Re – Reynolds number, [–]
Sc – Schmidt number, [–]
Sh – Sherwood number, [–]
St – Stanton number, [–]
U – velocity, [ms^{-1}]

Greek symbols

ρ – density, [kgm^{-3}]

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