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# MODIFICATION OF THE NON-HOMOGENEOUS EQUATION DEFINING THE HETP TO A FORM SATISFYING THE CHOSEN COHERENT SYSTEM OF UNITS

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**Abstract:** When performing calculations of any technological equipment or processes, one works with different types of equations. Equations can be written in various forms, while in the older literature one can also encounter equations that are dimensionally non-homogeneous. The article deals with the modification of non-homogeneous equations into a form that allows direct substitution of the values of physical quantities in a chosen coherent system of units. The procedure for adjusting the relationship is shown on the equation allowing to determine the height equivalent of the theoretical plate.

**Key words:** Theoretical stage, non-homogeneous equation, homogeneous equation, height equivalent theoretical stage (HETP), diffusion, mass transfer.

## 1. Introduction

In principle, the design or control of an industrial equipment cannot be carried out without some calculations. Different types of equations are used in these calculations. Equations (e.g., physical equations) use the mathematical symbols to express the relationships between quantities (physical quantities) that influence the course of processes (physical processes). A physical equation, unlike a mathematical equation, is not only a relationship of quantities, but also of qualities. This means that if a physical equation is correct, it must be true that both sides of the equation are expressed in the same units (e.g., the left side in meters, the right side in meters). If this condition is satisfied, then in this case it can be said that it is a dimensionally homogeneous equation [1, 2, 3]. However, it should be noted that dimensional homogeneity is not a guarantee of the correctness of the physical equation. It is only a necessary condition confirming the correctness of the form of the physical equation in terms of units. In the case of physical equations, it is also generally true that any of its additive terms must be represented by the same unit as the other terms of the equation. From this follows the well-known fact that if the corresponding equation is divided by any of its terms, then it turns into a new equation in which the units in each term are canceled. The form of such an equation is called dimensionless. Furthermore, if the equation is dimensionally homogeneous, it is also invariant with respect to any coherent system of units [4]. This means that the equation expressing some (e.g., physical) dependence always has the same form, including the values of the constants appearing in it, regardless of the chosen coherent system of units in terms of which the values of the (physical) variables appearing in the equation are expressed. A coherent system of units includes basic and derived units (i.e., dimensions) [5]. An example of a dimensionally homogeneous equation is the equation representing, for example, a free fall trajectory:

$$s = \frac{1}{2} g t^2 \tag{1}$$

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where *s* is the trajectory in m, *g* is the gravitational acceleration in m/s$^2$ and *t* is the time in s. On the basis of the above, it can be concluded that the values of the quantities given in this equation are expressed in the coherent system of SI units. By substituting units for all quantities appearing in Eq. (1), which can be written as follows $[\mathrm{s}] = \left[\frac{1}{2}\right][g][t^2]$ (i.e. the quantity in square brackets is the symbol representing the mark for the unit), it is possible to write:

$$\mathrm{m} = \left[\frac{1}{2}\right]\frac{\mathrm{m}}{\mathrm{s}^2}\mathrm{s}^2 = \left[\frac{1}{2}\right]\mathrm{m} \tag{2}$$

which implies that the dimension on the left side is equal to the dimension given on the right side of the equation. In other words, the number in parentheses has no dimension because $\left[\frac{1}{2}\right] = \frac{\mathrm{m}}{\mathrm{m}} = 1$. It also follows from this that the expression in square brackets represents only an ordinary number in Eq. (2), i.e., a dimensionless constant. If the values of the physical quantities Eq. (1) were expressed in another coherent system of units, the same number would be obtained. Based on the above, it can therefore be concluded that Eq. (1) is dimensionally homogeneous and also invariant.

The opposite of a dimensionally homogeneous equation is a dimensionally non-homogeneous equation [1, 2, 3]. In the literature, and not only in the older literature, one can commonly encounter such equations. Of course, the same also applies to technical practice, where calculations are very often performed using dimensionally non-homogeneous equations. In such cases, it is not appropriate to use the term physical equation, but one should work with the term mathematical equation. As an example, the equation:

$$\mathrm{s} = 4.905t^2 \tag{3}$$

which is non-homogeneous, despite the fact that the trajectory (*s*) is in m and the time (*t*) in s. The reason is the fact that the left side of the equation represents the value (of the term) expressed in m, while the right side represents the value (of the term) expressed in s$^2$. The above equation clearly shows that the constant (i.e., 4.905) is not dimensionless. In other words, in the case of Eq. (3), it is not true that the dimension on the left side of the equation is the same as the dimension given on the right side of the equation (i.e., $\mathrm{m} = [4.905]\mathrm{s}^2$). At the same time, it is also true that this equation is not even invariant. The reason for this is the fact that if the values of the quantities in Eq. (3) are expressed in another coherent system of units, the number 4.905 will change to another number. If the equation is dimensionally non-homogeneous, it is always the duty of its author to state in which units the values of the variables appearing in it should be given. Otherwise, the equation would be unusable. It should therefore be borne in mind that if an equation is to be used in calculations, its dimensional homogeneity must first be checked.

Further, the paper will show how a non-homogeneous equation can be modified into a form that allows direct substitution of the values of physical quantities in a chosen system of units. In general, however, such an adjustment may not result in a dimensionally homogeneous equation, which should always be kept in mind.

## 2. Conversion scheme of physical quantities

When carrying out calculations, values of quantities are often available which are expressed in other units than required. In this case, it is then necessary to transform such a quantity value into the required, recommended, system of units. A similar situation can arise when working with dimensionally non-homogeneous equations. The value of the quantity obtained from such an equation often does not correspond to the required system of units. Subsequently, the value obtained in this way is transformed into the desired system of units. Of course, this can also be

true for some other quantities appearing in the given dimensionally non-homogeneous equation. If such an equation is to be worked with more often, it is advantageous to transform it into a form in which the values of the variables corresponding to the chosen system of units will appear. In order to carry out the just mentioned transformations, it is necessary to know the physical equivalences, on the basis of which it is possible to convert different units of the relevant physical quantity. As an example, the physical equivalence of length can be mentioned: 1 m = 100 cm, 1 yd = 3 ft = 36 in = 0.9144 m. The numerical data given in the physical equivalences represent the conversion factor. An important property of physical equivalences is that these equivalences can be treated in the same way as algebraic equations. For example, there are two known equivalences: 1 m = 100 cm and 1 cm = 10 mm. These two equivalences can be combined, i.e., 1 m = 100 cm = 100 * 1 cm = 100 * 10 mm = 1 000 mm, which creates a new equivalence: 1 m = 1000 mm. In a similar way, various physical equivalences can be easily generated. For example, when the pressure given in kp/cm$^2$ has to be converted to pressure in Pa = N/m$^2$. In this case, it can be written: $1\,\frac{\text{kp}}{\text{cm}^2} = 1 * \frac{9.806*10^4\ \text{N}}{\text{m}^2} = 9.806 * 10^4\,\frac{\text{N}}{\text{m}^2}$, while the physical equivalences were used in the adjustment: 1 kp = 9.806 N and 1 cm$^2$ = 1/10$^4$ m$^2$. Thus, the physical equivalence was obtained in the form: 1 kp/cm$^2$ = 9.806*10$^4$ N/m$^2$. Physical equivalences, or conversion factors, are listed, e.g., in the literature [2, 3, 6, 7, 8, 9].

On the basis of physical equivalences, it is possible to construct a conversion relation for the corresponding physical quantity, the knowledge of which is important for the adjustment of dimensionally non-homogeneous equations. Let the physical equivalence be known in the form: 1 kp/cm$^2$ = 9.806*10$^4$ N/m$^2$. Two equations can be written on its basis, i.e., $p$ (kp/cm$^2$) = 1 kp/cm$^2$ = 1 and $p$ (N/m$^2$) = 9.806*10$^4$ N/m$^2$ = 9.806*10$^4$. If these two equations are combined into one, the relationship is obtained:

$$\frac{p\ (\text{kp/cm}^2)}{1*\text{kp/cm}^2} = 1 = \frac{p\ (\text{N/m}^2)}{9.806*10^4\ \text{N/m}^2},\ \text{or}\ \frac{p\ (\text{kp/cm}^2)}{1*\text{kp/cm}^2} = \frac{p\ (\text{N/m}^2)}{9.806*10^4\ \text{N/m}^2}, \tag{4}$$

which can also be written in a simplified form:

$$p\ (\text{kp/cm}^2) = \frac{1}{9.806 * 10^4}\,p\ (\text{N/m}^2) \tag{5}$$

The difference between these equations is that in the equations, strictly speaking, the product of a numerical figure and a unit should always be substituted for the value of the physical quantity. However, this method of substitution takes up a lot of space, and therefore a simpler notation is also allowed, which in this case is represented by Eq. (5). These equations (i.e., Eq. (4) and (5)) represent the conversion relationship of a given physical quantity. For example, the value of pressure in kp/cm$^2$ must be found when the pressure is known to be 3.04*10$^6$ N/m$^2$ (i.e., $p$ (N/m$^2$) = 3.04*10$^6$). By substituting the given data into Eq. (4), the result is obtained in the form: $\frac{p\ (\text{kp/cm}^2)}{1*\text{kp/cm}^2} = \frac{3.04*10^6\ \text{N/m}^2}{9.806*10^4\ \text{N/m}^2} \Rightarrow p\ (\text{kp/cm}^2) = 31\ \text{kp/cm}^2$. The same procedure is followed in the reverse case. Let the pressure value $p\ (\text{kp/cm}^2) = 31$ be known. Then, based on Eq. (5), it is possible to write: $31 = \frac{1}{9.806*10^4}\,p\ (\text{N/m}^2) \Rightarrow p\ (\text{N/m}^2) = 3.04 * 10^6$. For the sake of completeness, it is also possible to emphasize the meaning of the symbols (i.e., $p$ (kp/cm$^2$) or $p$ (N/m$^2$)) given in Eq. (4) and (5), which indicate that the pressure in the given equations is substituted in kp/cm$^2$ or in N/m$^2$. This means that Eq. (5) also clearly shows in which units the value of the corresponding physical quantity, in this case pressure, is obtained. Indeed, it is true that $p\ (\text{N/m}^2) = 3.04 * 10^6$ is the same as $p = 3.04 * 10^6\ \text{N/m}^2$.

It follows from the above that physical equivalence and the conversion relation are closely related. It also follows from the above that the conversion scheme, in terms of which the conversion relation can be obtained, is as follows:

$$1\ \frac{\text{kp}}{\text{cm}^2} = 9.806 * 10^4\ \frac{\text{N}}{\text{m}^2},$$

$$p\ \frac{1}{1}\left(\frac{\text{kp}}{\text{cm}^2}\right) = \frac{1}{9.806*10^4}\,p\ \left(\frac{\text{N}}{\text{m}^2}\right), \text{ or } p\left(\frac{\text{kp}}{\text{cm}^2}\right) = \frac{1}{9.806*10^4}\,p\ \left(\frac{\text{N}}{\text{m}^2}\right).$$

In this way, it is easy to obtain relations for various physical quantities and to convert the values of physical quantities from one unit to another. For example:

$$1\ \text{m} = 100\ \text{cm},$$

$$L(\text{m}) = \frac{1}{100}\,L\ (\text{cm}).$$

## 3. Transformation of a non-homogeneous equation into a form satisfying the chosen system of units

In the previous part of the article, it was shown how the value of a physical quantity expressed in one unit can be converted to a value expressed in other units. For this, it is necessary to know the relevant physical equivalence, on the basis of which a conversion relation can be easily constructed. In this section, it will be shown how to proceed when modifying a non-homogeneous equation into a form that will allow direct substitution of the values of the physical quantities in the chosen system of units. The adjustment procedure will be demonstrated on the equation (dimensionally non-homogeneous equation) allowing to determine the equivalent height of the theoretical plate, which according to [10] has the form:

$$\text{HETP} = K_1 G^{K_2} d^{K_3} h^{1/3} \left(\frac{\alpha\mu}{\rho}\right) \tag{6}$$

where:
HETP – height of packing equivalent to one theoretical plate, inches,
$G$ – mass velocity of vapor, pound per hour per sq. foot of tower cross-sectional area,
$d$ – tower diameter, inches,
$h$ – packed height, feet,
α – relative volatility, dimensionless,
μ – liquid viscosity, centipoises,
ρ – liquid density, grams per cc,
$K_1$, $K_2$, $K_3$ – constants (see Tab. 1), $[K_1] = \frac{[\text{HETP}]\ [\rho]}{[G]^{K_2}\ [d]^{K_3}\ [h]^{1/3}\ [\alpha]\ [\mu]}$, $[K_2] = 1$, and $[K_3] = 1$.

First of all, it is necessary to write the conversion relations for physical quantities that are required to be converted to another system of units. Let the following physical equivalences be applied in modifying the relation for HETP:

1 inch = 0.0254 m,
1 feet = 0.304800083149 m,
1 centipoise = 0.001 kg/(m.s),
1 pound per hour per sq. foot = 4.88242764 kg/(m$^2$.h),
1 gram per cc = 1 000 kg/m$^3$,
in terms of which, according to the above conversion scheme, the following conversion relations are obtained:

$\text{HETP (inch)} = \frac{1}{0.0254}\ \text{HETP (m)}$,

$G\ \text{(pound per hour per sq. foot)} = \frac{1}{4.88242764}\ G\ \left(\frac{\text{kg}}{\text{m}^2.\text{h}}\right)$,

$d\ \text{(inch)} = \frac{1}{0.0254}\ d\ \text{(m)}$,

$h\ \text{(feet)} = \frac{1}{0.304800083149}\ h\ \text{(m)}$,

$\mu\ \text{(centipoise)} = \frac{1}{0.001}\ \mu\ \left(\frac{\text{kg}}{\text{m.s}}\right)$,

$\rho\ \text{(gram per cc)} = \frac{1}{1000}\ \rho\ \left(\frac{\text{kg}}{m^3}\right)$.

Tab. 1 Constants in Eq. (6) by [10].

| Type of packing | Size [in] | $K_1$ | $K_2$ | $K_3$ |
|---|---|---|---|---|
| Rings | 3/8 | 2.100 | - | 1.24 |
| | 1/2 | 8.530 | 0.37 | 1.24 |
| | 1.0 | 0.570 | - | 1.24 |
| | 2.0 | 0.420 | 0.24 | 1.24 |
| Saddles | 1/2 | 5.620 | - | 1.11 |
| | 1.0 | 0.760 | 0.10 | 1.11 |
| McMahon | 1/4 | 0.017 | 0.00 | 1.00 |
| | 3/8 | 0.200 | - | 1.00 |
| | 1/2 | 0.330 | 0.45 | 1.00 |
| Protruded | 1/4 (0.16) | 0.390 | - | 0.30 |
| | 3/8 (0.24) | 0.076 | 0.14 | 0.30 |
| | 1.0 | 3.060 | 0.50 | 0.30 |
| Stedman | No. 128 | 0.077 | 0.25 | 0.24 |
| | (2.0) | 0.363 | 0.20 | 0.24 |
| | No. 107 | 0.218 | 0.25 | 0.24 |
| | (3.0) | | 0.50 | |
| | No. 115 | | 0.12 | |
| | (6.0) | | 0.48 | |
| | | | 0.26 | |
| | | | 0.32 | |

By substituting these conversion relations into Eq. (6), it is obtained an equation of the form:

$\frac{\text{HETP (m)}}{0.0254} = K_1 \left(\frac{G\left(\frac{\text{kg}}{\text{m}^2.\text{h}}\right)}{4.88242764}\right)^{K_2} \left(\frac{d\ \text{(m)}}{0.0254}\right)^{K_3} \left(\frac{h\ \text{(m)}}{0.304800083149}\right)^{1/3} \left(\frac{\alpha\frac{\mu\left(\frac{\text{kg}}{\text{m.s}}\right)}{0.001}}{\frac{\rho\left(\frac{\text{kg}}{m^3}\right)}{1000}}\right)$, which can be rewritten in the form:

$$\frac{\text{HETP}}{G^{K_2} d^{K_3} h^{1/3} \left(\frac{\alpha\mu}{\rho}\right)} = \frac{K_1 \times 1000 \times (0.0254)^{(1-K_3)}}{(4.88242764)^{K_2} (0.304800083149)^{1/3} \times 0.001} = K_1^* \qquad (7)$$

from which follows the equation for determining the value of the constant $K_1^*$, as well as its dimension. It is evident that equation:

$$\text{HETP} = K_1^* G^{K_2} d^{K_3} h^{1/3} \left(\frac{\alpha\mu}{\rho}\right) \qquad (8)$$

so applies. Both equations, similar to Eq. (6), are dimensionally non-homogeneous and therefore not invariant either. For this reason, it must be clearly stated in which units the values of the relevant physical quantities are to be substituted into these equations. In the case of these equations (i.e., Eq. (7) and (8)), it is true that:

HETP – height of packing equivalent to one theoretical plate [m],
$G$ – mass velocity of vapor related to tower cross-sectional area [kg/(m$^2$.h)],
$d$ – tower diameter [m],
$h$ – packed height [m],
α – relative volatility [1],
μ – liquid viscosity [kg/(m.s)],
ρ – liquid density [kg/m$^3$],
$K_1$, $K_1^*$, $K_2$, $K_3$ – constants (see Tab. 2), $[K_1] = \frac{[\text{HETP}]\,[\rho]}{[G]^{K_2}\,[d]^{K_3}\,[h]^{1/3}\,[\alpha]\,[\mu]}$, according to Eq. (6), $[K_1^*] = \frac{[\text{HETP}]\,[\rho]}{[G]^{K_2}\,[d]^{K_3}\,[h]^{1/3}\,[\alpha]\,[\mu]}$, $[K_2] = 1$, and $[K_3] = 1$.

Tab. 2 Constants in Eq. (7) and (8) obtained from Eq. (6).

| Type of packing | Size [in] | $K_1$ | $K_1^*$ | $K_2$ | $K_3$ |
|---|---|---|---|---|---|
| Rings | 3/8 | 2.100 | 13 547 196.4 | -0.37 | 1.24 |
| | 1/2 | 8.530 | 1 | -0.24 | 1.24 |
| | 1.0 | 0.570 | 44 777 156.1 | -0.10 | 1.24 |
| | 2.0 | 0.420 | 8 | 0.00 | 1.24 |
| Saddles | 1/2 | 5.620 | 2 396 477.29 | -0.45 | 1.11 |
| | 1.0 | 0.760 | 1 506 899.09 | -0.14 | 1.11 |
| McMahon | 1/4 | 0.017 | 25 532 050.6 | 0.50 | 1.00 |
| | 3/8 | 0.200 | 1 | 0.25 | 1.00 |
| | 1/2 | 0.330 | 2 111 960.89 | 0.20 | 1.00 |
| Protruded | 1/4 (0.16) | 0.390 | 11 432.10 | 0.25 | 0.30 |
| | 3/8 (0.24) | 0.076 | 199 924.50 | 0.50 | 0.30 |
| | 1.0 | 3.060 | 357 093.34 | 0.12 | 0.30 |
| Stedman | No. 128 | 0.077 | 29 804.66 | 0.48 | 0.24 |
| | (2.0) | 0.363 | 3 907.28 | 0.26 | 0.24 |
| | No. 107 | 0.218 | 287 384.74 | 0.32 | 0.24 |
| | (3.0) | | 3 278.04 | | |
| | No. 115 | | 21 904.33 | | |
| | (6.0) | | 11 960.84 | | |

A similar procedure would be followed if all quantities were required to be expressed in the relevant coherent system of units (e.g., in the SI system of units). In this case, Eq. (6), or Eq. (8), goes into the form:

$$\frac{\text{HETP}}{G^{K_2} d^{K_3} h^{1/3} \left(\frac{\alpha\mu}{\rho}\right)} = (3600)^{K_2} \times K_1^* = K_1^{**},$$

$$\frac{\text{HETP}}{G^{K_2} d^{K_3} h^{1/3} \left(\frac{\alpha\mu}{\rho}\right)} = \frac{K_1 \times 1000 \times \left(\frac{3600}{4.88242764}\right)^{K_2} \times (0.0254)^{(1-K_3)}}{(0.304800083149)^{1/3} \times 0.001} = K_1^{**}, \quad (9)$$

$$\text{HETP} = K_1^{**} G^{K_2} d^{K_3} h^{1/3} \left(\frac{\alpha\mu}{\rho}\right).$$

in which HETP – height of packing equivalent to one theoretical plate [m],
$G$ – mass velocity of vapor related to tower cross-sectional area [kg/(m$^2$.s)],
$d$ – tower diameter [m],
$h$ – packed height [m],
α – relative volatility [1],
μ – liquid viscosity [kg/(m.s)],
ρ – liquid density [kg/m$^3$],
$K_1$, $K_1^*$, $K_1^{**}$, $K_2$, $K_3$ – constants (see Tab. 3), $[K_1] = \frac{[\text{HETP}]\ [\rho]}{[G]^{K_2}\ [d]^{K_3}\ [h]^{1/3}\ [\alpha]\ [\mu]}$, according to Eq. (6), $[K_1^*] = \frac{[\text{HETP}]\ [\rho]}{[G]^{K_2}\ [d]^{K_3}\ [h]^{1/3}\ [\alpha]\ [\mu]}$, according to Eq. (8), $[K_1^{**}] = \frac{[\text{HETP}]\ [\rho]}{[G]^{K_2}\ [d]^{K_3}\ [h]^{1/3}\ [\alpha]\ [\mu]}$, $[K_2] = 1$, and $[K_3] = 1$.

Tab. 3 The constants in Eq. (9) obtained from Eq. (6), or Eq. (8).

| Type of packing | Size [in] | $K_1$ | $K_1^*$ | $K_1^{**}$ | $K_2$ | $K_3$ |
|---|---|---|---|---|---|---|
| Rings | 3/8 | 2.100 | 13 547 196.41 | 654 662.56 | - 0.37 | 1.24 |
| | 1/2 | 8.530 | | 6 273 991.24 | | 1.24 |
| | 1.0 | 0.570 | 44 777 156.18 | | - 0.24 | 1.24 |
| | 2.0 | 0.420 | | 1 056 678.98 | | 1.24 |
| Saddles | 1/2 | 5.620 | 2 396 477.29 | | - 0.10 | 1.11 |
| | 1.0 | 0.760 | 1 506 899.09 | 1 506 899.09 | | 1.11 |
| McMahon | 1/4 | 0.017 | 25 532 050.61 | | 0.00 | 1.00 |
| | 3/8 | 0.200 | | 640 839.94 | - 0.45 | 1.00 |
| | 1/2 | 0.330 | 2 111 960.89 | 671 125.16 | | 1.00 |
| Protruded | 1/4 (0.16) | 0.390 | 11 432.10 | 685 925.96 | - 0.14 | 0.30 |
| | 3/8 (0.24) | 0.076 | 199 924.50 | 1 548 608.50 | | 0.30 |
| | 1.0 | 3.060 | 357 093.34 | | 0.50 | 0.30 |
| Stedman | No. 128 (2.0) | 0.077 | 29 804.66 | 1 836 717.02 | 0.25 | 0.24 |
| | | 0.363 | 3 907.28 | | 0.20 | 0.24 |
| | No. 107 (3.0) | 0.218 | 287 384.74 | 230 865.93 | 0.25 | 0.24 |
| | | | 3 278.04 | 234 436.65 | 0.50 | |
| | No. 115 (6.0) | | 21 904.33 | 767 750.31 | 0.12 | |
| | | | 11 960.84 | 166 970.34 | 0.48 | |
| | | | | 184 148.66 | 0.26 | |
| | | | | 164 353.30 | 0.32 | |

After making the necessary adjustments, as is generally the case in problem when solving tasks, if possible, the obtained result must be checked. If the above equations are adjusted correctly, the results obtained on their basis must be identical. Let it be true that the goal is to design a packing column for which: $G$ = 1 690.0 kg/(m$^2$.h) = 346.139282465 lb/(ft$^2$.h) = 0.469444 kg/(m$^2$.s), $d$ = 0.150 m = 5.90551181102 in, $h$ = 2.4 m = 7.874014 ft, α = 2.25, μ = 0.55 cP = 0.00055 Pa.s, ρ = 0.73 g/cm$^3$ = 730 kg/m$^3$ (data taken from literature [11]). Based on Eq. (6), the value of the quantity HETP = 9.688655644 in (i.e., 0.246091853 m) is obtained, if the packing is formed by Raschig rings of size 1.0 in (when, in terms of Tab. 1, the following applies: $K_1$ = 0.57, $K_2$ = - 0.10, and $K_3$ = 1.24). It can be easily ascertained that the same value (i.e., HETP = 0.246091853 m) is also obtained in terms of Eq. (8), or Eq. (9).

## Conclusion

The paper documents that dimensionally non-homogeneous equations are commonly encountered in the literature. The correctness of the results obtained in terms of such equations depends on the observance of a prescription which determines in which units the values of the quantities appearing in the given relation are to be stated. If no such prescription is available, the origin of the equation must be sought, where the prescription should be given. The paper then presents a method by which the non-homogeneous equation can be modified into a form that satisfies the chosen coherent system of units.

When setting up equations, the introduction of dimensional constants and conversion factors into the equations should be avoided, and the aim should always be to make the equation dimensionally homogeneous. Introducing dimensional constants and conversion factors into physical equations creates the danger of incorrectly assigning values to physical quantities and, in addition, obscures the true physical meaning of the equations. It should therefore always be borne in mind that, in general, any equation, including newly constructed equations, should always be subjected to a dimensional homogeneity check.

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