

ENERGY

In this article, we present another concept which has become increasingly familiar in recent times. It is called exergy. When we speak of energy, we usually mean a difference in energy. We say that a bucket of water lifted out of the sea has potential energy, meaning that its potential energy has been altered by the act of lifting. In everyday terms, we refer to the difference as "energy".

When specifying a certain energy level, it is essential to know the level to which this is referred. A bucket of water placed on a table has one given potential energy in relation to floor level, another in relation to the surface of an adjacent lake, a third in relation to the surface of the sea, a fourth in relation to the bottom of the sea and so on.

If we select the sea bed at the deepest point of the sea as reference level, we gain the advantage that the potential energy of our bucket of water on the table is a positive value in all cases. In addition to this, it possesses a great deal of energy. However, it is obvious that we cannot utilize all of this since there is no way in which we can make it fall all the way to the bottom of the sea. Therefore, in a house in which the floor is the lowest possible level, it may be practical to define the potential energy with reference to the floor rather than to the seabed. In this way, we specify the useful potential energy rather than the total value with respect to the sea bed.

In the case of thermal energy, the temperature corresponds to the height of the water while the sea bed represents absolute zero. And just as we cannot under given conditions utilize the full potential energy of our bucket of water in relation to its height above the sea bed, neither can we under given conditions utilize the full thermal energy represented by a specific temperature above absolute zero.

So in the case of thermal energy too, it may be more appropriate to define the energy using the ambient temperature rather than absolute zero as our reference level. In this manner, we define the useful thermal energy rather than the total value referred to a temperature of absolute zero.

"If you want an important project to succeed then you must put your best man on it, not the one who could most easily be spared, but the one who it really hurts to take away from his present duties".

MR. L. DALE — WORKS DIRECTOR —
DIMPLEX.

It pays well to REMEMBER this; when you think of introducing energy conservation programme in your institution.

Similarly, in the case of energy forms other than potential energy and heat, it is possible to define reference levels which always produce positive values. Nevertheless it may be preferable to use reference levels which are tangible in practical terms. This creates the problem of specifying energy in relation to various reference levels. The use of different descriptions to describe how the reference level has been chosen has been proposed to distinguish between the concept. The terms energy, exergy and anergy, defined as follows, have been suggested:

Energy = energy in relation to the lowest possible reference level

Exergy = energy in relation to the level of the surroundings

Anergy = Energy — Exergy

Thus, exergy is the portion of the energy which is useful under specified conditions.

A conversion factor usually known as the Carnot efficiency is used for converting from energy to exergy and vice versa. If a quantity of energy E_{en} at an absolute temperature T_1 is transferred together with its entropy to a large environment at a temperature of T_2 , the useful energy, i.e. the exergy, will be

$$E_{ex} = \frac{T_1 - T_2}{T_1} E_{en}$$

the Carnot efficiency being defined by the expression

$$c = \frac{T_1 - T_2}{T_1}$$

The term "efficiency" is perhaps not the happiest of choices since it gives the impression of being a factor which describes some type of loss in the conversion which, of course, is not the case. The factor c is used for converting from one reference level to another and has nothing to do with the efficiency of conversion between various forms of energy.

It is clear that our problem is to conserve exergy rather than energy. The fact that the quantity of energy is greatly increased by selecting a low reference level is obviously of no interest since we cannot utilize a level lower than that available to us in our environment. In other words, we can only use the exergy portion of the energy. A change-over from energy accounting to exergy accounting would, therefore, appear to be an obvious step. However, one reason for not taking this step is the fact that environmental reference levels (ambient temperature, height, etc.) have not been defined in constant, unambiguous terms.

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M.Sc. — With Acknowledgement to "Energy Technology of Sweden").

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