WIKIPEDIA
The Free Encyclopedia

Rate of heat flow

The **rate of heat flow** is the amount of heat that is transferred per unit of time in some material, usually measured in watt (joules per second). Heat is the flow of thermal energy driven by thermal non-equilibrium, so the term 'heat flow' is a redundancy (i.e. a pleonasm). Heat must not be confused with stored thermal energy, and moving a hot object from one place to another must not be called heat transfer. However, it is common to say ‘heat flow’ to mean ‘heat content’.[1]

The equation of heat flow is given by Fourier's Law of Heat Conduction.

Rate of heat flow = - (heat transfer coefficient) * (area of the body) * (variation of the temperature) / (length of the material)

The formula for the **rate of heat flow** is:

$$\frac{Q}{\Delta t} = -kA\frac{\Delta T}{\Delta x}$$

where

- Q is the net heat (energy) transfer,
- Δt is the time taken,
- ΔT is the difference in temperature between the cold and hot sides,
- Δx is the thickness of the material conducting heat (distance between hot and cold sides),
- k is the thermal conductivity, and
- A is the surface area of the surface emitting heat.

If a piece of material whose cross-sectional area is A and thickness is Δx with a temperature difference ΔT between its faces is observed, heat flows between the two faces in a direction perpendicular to the faces. The **time rate of heat flow**, $\frac{Q}{\Delta t}$, for small Q and small Δt, is proportional to $A \times \frac{\Delta T}{\Delta x}$. In the limit of infinitesimal thickness Δx, with temperature difference ΔT, this becomes $H = -kA(\frac{\Delta T}{\Delta x})$, where $H = (\frac{Q}{\Delta t})$ is the time rate of heat flow through the area A, $\frac{\Delta T}{\Delta x}$ is the *temperature gradient* across the material, and k, the proportionality constant, is the *thermal conductivity* of the material.[2] People often use k, λ, or the Greek letter κ to represent this constant. The minus sign is there because the rate of heat flow is always negative—heat flows from the side at higher temperature to the one at lower temperature, not the other way around.[3]

See also

energy portal

- Heat transfer coefficient
- Heat transfer
- Thermal conduction
- Thermal conductivity
- Heat flux
- Watt
- Flux

References

1. http://webserver.dmt.upm.es/~isidoro/bk3/c11/Heat%20and%20mass%20transfer.pdf
2. "52.09 -- Heat conduction in various metal rods" (http://web.physics.ucsb.edu/~lecturedemonstrations/Composer/Pages/52.09.html). *web.physics.ucsb.edu*. Retrieved 2019-05-07.
3. "Unit Operations in Food Processing - R. L. Earle" (https://nzifst.org.nz/resources/unitoperations/httrtheory2.htm). *nzifst.org.nz*. Retrieved 2019-05-07.