Mechanisms of the processes of shear, slice, general compression and expansion of mass

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Abstract. The analysis of the features of the physico-mechanical and physico-chemical properties of undeformed and twisted mechanical deformations of shear, compression, bending, torsion, and slice is carried out. Special attention is paid to the analysis of the processing of the qualitative state of materials, which should change when the production requirements are met and move to a new stable state in the resulting products.

1 Introduction

Types of deformation are divided into reversible (elastic) and irreversible (plastic, creep). Reversible deformations disappear after the end of the applied forces, and irreversible ones remain. Reversible deformations are based on the displacement of the atoms of the body from the equilibrium position, irreversible ones are based on irreversible movements of atoms at distances from the initial equilibrium positions (after the load is removed, reorientation occurs to a new equilibrium position). Deformation is defined as the ratio of the change in the length of a deformed object to its initial length. The deformation has no physical dimension. Types of deformation: shear, compression, crumpling, bending, torsion, slice.

2 Methods

The shift of material particles relative to each other is not accompanied by the separation and destruction of the bond between the particles, which can lengthen and shorten during the movement of individual particles without the accumulation of energy in them (plastically) or transition to a stressed state when striving for a balanced state (elastically).

When the particles are cut off from each other, the bonds disappear and their energy passes into a free state, destroying neighboring bonds or radiating into the surrounding space. These processes are mathematically inverse to each other:

$$\varepsilon_o = \mathrm{A}_2 m_0 \; u \; \varepsilon_o = \frac{\mathrm{A}_2}{m_0}$$

and when combined, the resulting value

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$$\varepsilon_o = A_0.$$

The internal friction and adhesion of the particles prevents both shear and shear differently. This determines the occurrence of either a shift or a slice in the processes of interaction of mass particles. The occurrence of one of the two processes prevents the occurrence of the other. This is the opposite of these processes.

The general pattern – the direct proportionality of the energy level to the mass during the shift and the inverse proportionality during the cut – characterizes the influence of mass – the quantitative expression of substances – on the energy level – the qualitative state of substances.

With an internally balanced, stable state of a substance, its energy level $\varepsilon_o = A_0$ (J/kg) = const. With an increase in the mass interacting with external influences in the process, the probability of a shift increases and the probability of a cut decreases. Reducing this mass produces the opposite effect.

3 Results

Figure 1 shows that the shift occurs when the mass increases from 1 to e units of mass (the smallest value of m in atomic units). At $m_0 = e$, the substance reaches the upper critical level, i.e. it is oversaturated with energy. At $m_0 = \frac{e}{1}$, the substance also reaches the upper critical level. Only in the first case, the upper critical level is reached during the shift, in the second during the cut. With reverse mass changes, the substance reaches the lower critical level $m_0 = \frac{1}{e}$ with a shift $m_0 = e$ at the cut.

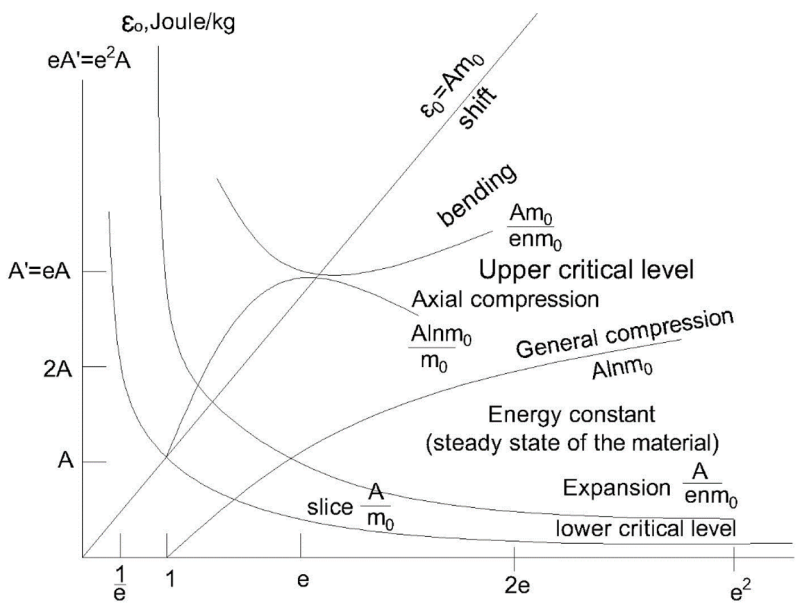

Fig. 1. The energy level of materials $\varepsilon_o = A\, f\,(m_0)$.

At the lower critical level in substances, energy is depleted to the limit at which its qualitative state cannot be preserved and the substance is destroyed – it breaks up into composite particles as a result of the disappearance of the bonds between them. At the upper critical level, the energy-saturated particles of the mass, having a reserve of free energy, can

interact with each other in various ways and even "jump out" from the mass into the surrounding space, which is observed with all kinds of explosions and radiation.

The interaction of particles with a high energy content can lead to the formation of new, stronger bonds between particles during the formation of new structures of substances with a new, increased energy constant A'=eA, for which the former energy constant A becomes the lower critical level. The upper critical level for the new energy constant A' will be the value εo =eA'=e^2A.

The stepwise rise of the energy constant of substances proportional to the base of natural logarithms is a general law in the problem of the structure of substances. Different structures of the same substance are determined by their different qualitative states: for example, carbon occurring in the form of coals, graphite, diamond. This law allows us to consider the process of energy accumulation by substances and radiation from them within the critical levels from A= const to e^n and up to e^{-n} when n= 1,2,..

For water, whose properties in physics have served to create numerous units of measurement, n = 1 at A = 837.36 J and critical levels close to the experimentally obtained values that occur during the transition of water to a solid and vaporous state.

Shear and slice, considered separately from other types of resistance of materials to external influences, are combined in space and time with a general compaction and expansion of the mass. The resulting more complex combined processes of axial compression, stretching, bending, torsion have, like the processes considered, the opposite and unity: the direct and inverse effect of f (m_0) on the energy level of substances.

In the expression of the coefficient f (m_0), there is ln m_0, which turns into 1 when m_0=e.. This shows the action of the exponential law in the field of interaction of energy and mass of substances.

The process of mass compression is accompanied by an increase in its density γ = $\frac{m_0}{q}$ (kg/sm3), and the expansion process is correspondingly accompanied by a decrease in γ.

A compressible and expanding body retains a constant value of m_0. Due to the convergence of particles during compression, energy accumulates in the mass

$$\varepsilon_0 m_0 = A \int_e^{e^2} ln\, m_0 dm_0 \text{ (J)} = A\,(e^2 \cdot 2 - e^2 - e + e) = Ae^2.$$

$$\text{At } m_0 = e^2 \;\; \varepsilon_0 = 2A; \text{ at } m_0 = e \;\; \varepsilon_0 = A.$$

The curve ε_0 = Aln m_0 at m_0 = e2 gives ε_0 = 2A,, and then, slowly increasing, reaches the upper critical level e2A only at при m_0=15,2 = e5,627, at which the mass compaction process should be completed.

The curve ε_0= $\frac{A}{ln m_0}$, which characterizes the general expansion of the mass, reaches the upper critical level much sooner.In this case, the critical value m_0=1,44 and the mass particle containing energy reserves should fly apart in space, colliding with each other and the particles of the environment.

At the lower critical level, and even before reaching it at m_0 = e2, when ε_0 = 0,5 A, the mass decays into composite particles due to the depletion of internal energy.The separation and decay of particles are opposite processes, combined by the separation of particles from each other. The very opposite of the processes of compression and expansion indicates the possibility of mutual compensation of these processes, leading to a stable state of mass ε_0 = A = $\sqrt{\varepsilon_{0-3}\varepsilon_{0-4}}$ (J/kg).This is possible with $\sqrt{A_3 A_5}$ = A.

The analysis of shear-slice processes and the general expansion and compression of the mass – the basic elementary processes of resistance of materials to external influences – can be continued by considering the opposite processes: axial compression and stretching, bending and torsion. These processes, under certain conditions, can compensate for each other, bringing the mass into a balanced stable state. The expression of the energy level of

materials before the start of their processing is characterized by their energy constants A in a stable, internally balanced state.

As a result of various types of processing, the qualitative state of materials should change when the production requirements are met and move to a new stable state in the resulting products. At the same time, the expression of the energy level of the processed materials εo = A f (m_0) can take very complex variants due to various combinations and compounds in the production processes of elementary processes.

Combined elementary processes and carried out sequentially one after the other give the algebraic sum $\sum\varepsilon_{0-i}=\varepsilon_0$ (J/kg).At the same time, the production process is characterized by the equation εdm = *kNdt* (J), which is solved by clarifying the functional dependencies between the energy level and mass and between the useful energy and time.

4 Conclusion

Considering the main problem of natural sciences – the "structure of substances" from an energy point of view, we get the opportunity to penetrate into the mechanism of the processes of quantitative and qualitative changes of substances.

Solving the equations of production processes leads to the identification of interrelations of the main indicators of processes in the form of equality $\varepsilon_0 m_0 = kN_0 t_0$ (J), expressed by nomograms that allow you to set the optimal – highest values of efficiency $k = \frac{\varepsilon_0 m_0}{N_0 t_0}$ and the values of the technical level of processes $\frac{k}{\varepsilon_0}$, productivity , etc.

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