Obsolescence of metal materials and products

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Abstract. It is shown that the degradation of materials is a complex field, for which it becomes necessary to launch on the knowledge market a new scientific branch, Material Degradation Engineering. To analyse the degradation of materials, it is recommended to use the ecotechnological paradigm, on the basis of which the knowledge of the negative (entropic) effects of degradation can be deepened. In this paper, we define, characterise and reason the forms of materials obsolescence, i.e. the unplanned and the planned obsolescence. Taking as example the steel, which is a durable-sustainable material, we present some ways to minimize the negative effects of the material obsolescence.

1. Introduction
The material lifecycle consists of the main sequences given by the following diagram [12, 13], as can be seen in Figure 1. Here is a brief analysis of the lifecycle, referring to elements of dialectics and Chinese ancient philosophy regarding the yin-yang couple (which is a unitary, but contradictory couple: light - darkness) [9].

Figure 1. Material lifecycle.

The lifecycle (l.c.) is the result of two major and contradictory events.
The first is the process of achieving the performance of materials. In this case, the material engineer, through successive technological processes, induces successive super-orderings of the substance. So, the final stage is reached (advanced material) [15]. According to the Chinese philosophy, it has become a yin material (bright material).

The second event consists of a continuous decrease of the ordering degree of the substance, i.e. a degradation of the ordering [7]. Finally, the material reaches a disordered and degraded state, which is called residue. According to the Chinese philosophy, it has become a yang material (dark material).

Starting from the above characterisation of the lifecycle, we can deduce that it can be analysed on the basis of the law of unity of opposites.

The second event is still a subject of analysis.

Regarding the knowledge of the degradation of the materials, there are some shortcomings, such as those presented selectively below.

- The multiple degradation processes have not been uniformly investigated, based on a general theory of degradation; there is a sectoral approach: chemical degradation, physical degradation, mechanical degradation, etc.
- In almost all situations, the degradation was investigated only in the use phase, neglecting the fact that it occurs throughout the material lifecycle.
- The studies on materials degradation do not currently include the reintegration solutions, based on 3R technologies, of the waste generated by degradation.
- The most important shortcoming is that the knowledge of degradation processes is not currently based on the ecological-technological (ecotechnological) paradigm.
- Developed in the spirit of the durable-sustainable development concept, it considers that, in the human sphere, the natural-ecological system (S.N.E.) is of primordial importance, being called the foundation system, because it is:
  - Provider of natural resources (n.r.);
  - Storage basin for polluting residues.

In contrast to it, the technological system (T.S.), which is a material manufacturer, is called parasitic system [14].

- The use of this paradigm would enable the deep understanding and mitigation of the negative effects of degradation, which are:
  - On the one hand, the degradation determines the increase of specific consumption of natural resources, which leads to natural imbalances and decrease of the stocks supporting the economy;
  - On the other hand, the degradation causes residues which are disposed in the environment as pollutants.
- The aforementioned statements are clearly putting aside the ecological essence of the material degradation phenomena, which have not been studied so far.
- It is obvious that the degradation of materials are seriously affecting the care for future generations and that, in this context, it becomes a negative issue of durable-sustainable development [12].

In a situation such as the one above, the authors consider it necessary to establish a new scientific branch, called Material Degradation Engineering (M.D.E.), which is an essentially ecotechnological field.

The Material Degradation Engineering is the science that deals with:

- The defect-generating processes which, by prematurely or normally removing from use of the materials, causes the destruction of the functional integrity of the materials embedded in industrial products with a social purpose.
- The technical and technological solutions aiming to reduce the premature removal from use and remedy the defects, in order to reintroduce the secondary materials generated by degradation into the manufacturing circuits, by reintegration (the 3R technologies).

The types of degradation are:
- Conventional degradation (corrosion, erosion, exfoliation, etc);
• Unconventional degradation:
  o Environmental degradation;
  o Obsolescence.

2. Materials and methods
In this paper we used documentary materials on the development of technological processes in interacting with social phenomena.
Computer materials on the random nature of technologies that cause perverse effects.
The methods used for this research were:
  o interdisciplinary research; the topic of research is in the convergence zone between the technological system (m) and the social system (n);
  o characterization and identification characterization and identification of technological processes in interaction with social needs;
  o ecotechnological paradigm application;
  o processing existing information to raise them to the level of global knowledge;
  o expressing the thought and opinions of the authors about existing knowledge.

3. Results and discussion
The research were focused on getting knowledge on the obsolesce phenomena for materials and metallic products.
The obsolescence of materials is the event with technological, economic, ecological and socio-legal connotations, which consists in replacing the materials and products before reaching the time for removal from use – which was originally established by engineers on standardized bases (premature replacement) – for objective or subjective causes, whether legal or illegal.
The types of material obsolescence are:
  o Unplanned obsolescence;
  o Planned obsolescence.

3.1 The unplanned obsolescence of materials
The unplanned obsolescence is the degradation due to causes independent of the designing and manufacturing of the material, which were made based on the standards and rules imposed by the initial level of the technologies [5-6].

3.1.1 Obsolescence depending on the user’s (consumer’s) standard of living and equipment performance. About this type of obsolescence we can say that:
  o It consists of the replacement of a functional material due to the launch on the market of a qualitatively and economically superior material [4];
  o It is a voluntary action of removal from use before its end-of-life, due to the consumers’ desire to own more tempting products, even if their current products are still meeting the functional quality parameters [5];
  o To a great extent, this action has a pseudo-subjective character, because it does not depend on the projects and products originally launched, being often just a case of personal perception.

3.1.2 Obsolescence depending on various disturbances in the manufacturing systems. This is the type of obsolescence that causes the premature removal from use due to causes such as those listed below.
  o The technologies have characteristics that are more likely subjective than objective [4];
  o The technologies have an uncertain and variable character, because they are conditioned by the operators’ personality and interpersonal relationships;
  o The technologies are based on learning by experience, as their operationalization depends on the advanced level of manufacturers’ training;
  o Many times, the new technologies are unrepeatable, so they are unique, being no standards applicable to them;
  o The technologies can induce perverse effects, caused by occurrence of unexpected side effects.
Thus, it can be said that materials manufacturing technologies can often have a very random character.

3.2 The planned obsolescence of materials

It is astonishingly clear today that some modern equipment and devices are operating less time than the same types existing on the market in the past years. The explanation of this situation is what is called in this paper the obsolescence planned by the human factor [3].

The planned obsolescence is the type of degradation deliberately induced without complying with the standards and rules existing in the spheres of design, manufacture and use of materials.

3.2.1 The obsolescence planned in the manufacturing process. The obsolescence planned in the manufacturing process is characterized by the rejection of materials and products due to their dubious quality, as a result of the conscious but illegal and anti-social violation of the international manufacturing standards by some corrupt, profit-making manufacturers who are not interested in meeting the quality and safety standards imposed by legislation.

This can be seen in the lifecycle phases represented by design and manufacturing.

It is increasingly emphasized that the manufacturing obsolescence of materials and products is a consequence of the global moral breakdown of the society, determined in particular by corruption.

The causes leading to this type of degradation are multiple. Here are a few of them:

- Poor legislation on non-compliance with the quality and safety standards [10];
- Increased chain of subcontractors [11];
- The existence of institutional anomie; the institutional anomie theory (IAT) states that the institutional system in which the economy (market) is dominating other areas without restriction (i.e. politics, family) is harmful or even criminogenic [2];
- The existence of corporate illegality; the theory of corporate illegality (TCI) certifies the existence of moral degradation in the processes of designing and manufacturing of materials and products [1];
- The existence interference of political and administrative factors.

3.2.2 Obsolescence planned in use of materials. The obsolescence planned in use consists in the wilful limitation of the use phase of lifecycle, artificially and deliberately, carried out by the manufacturer of the product.

It essentially consists in interrupting the operation of the product independently of the user’s will. This is due to a pact concluded in 1924 by which a group of dominant manufacturers, known as the Phoebus Cartel, launched the planned obsolescence in the world.

In fact, a mechanism inside the equipment is scheduled lead to removal from use.

The technological equipment is, as a value, the most affected area by this type of degradation.

The consumer society is the form of economic and social organization in which the obsolescence has a strong ally.

The consumism and consumerism are two states that characterize the consumer society. Although not all authors agree, the consumerism is considered to be an excessive concern for consumption, and consumism refers to the actions aimed to defend the consumers’ interests.

3.3 The reduction of the negative effects of degradation of materials

The M.D.E. designs specific policies and technologies able to mitigate the negative effects of degradation. We are going to present some aspects in this respect concerning the siderurgy, the industrial branch producing steel, which fulfils the multifunction of durable and sustainable material. We will insist on the performance of siderurgy and steel that deal with the fight against degradation.

a) One of the fundamental ways is the maximization of the use phase duration, \(D_u\) [years]. In this case, I.D.M. recommends \(D_u\) to be calculated from two parts:

\[
D_u = D_{u1} + D_{u2} \quad \text{[years]}
\]

In the above relation:
- $D_1$ is the duration of the actual use phase that runs from manufacturing to the removal from use;
- $D_2$ is the duration of pseudo-use, additionally induced by the re-integration of secondary materials (waste) by 3R technologies, after the removal from use.

b) The steel industry undertakes the responsibility to obtain added value. In this context, it ennobles the ore (in a car, 80% of the ore supplied by the environment is exported). The high added value justifies the demand for steel in the top branches.

c) By providing flexibility and compatibility, the steel industry adapts to changes induced by the suppliers and consumers.

d) The steel industry implements forward-looking efficiency policies, assuring the consumers about the maximization of the use phase.

e) The steel industry has already launched the new product policy, based on which it makes durable and sustainable materials.

f) The steel industry has assimilated the steel-plus concept, which involves its transformation from simple material to construction systems realised by the steel industry.

g) In the industrial culture, the steel is a conscientious material, concerned with the accumulation of knowledge that leads to the reduction of degradation effects.

h) The steel is a stubborn material, i.e. by reinstatement in the recovery of waste it comes back and does not give up the struggle against degradation, which is permanent.

i) In addition to the material flow sent by the steel industry to the social system (S.S.), it is also transferring an immaterial flow, objectified in the joy of living of the consumer of high performance metal products [15].

j) Steel is permanently concerned with the emotional state induced among metal users. Thus, at the Hanover International Exhibition (2000), a church built exclusively of steel was exposed and this event generated the answer the church trusts in steel.

k) The steel is an industrial fitness practitioner. After the steelmaking process, when it is still weak, it enters a fitness hall (heat treatment workshop), is subjected to an industrial massage (heat treatment), and comes out hardened and able to fight the degradation.

l) The house (family) in which the steel lives and is educated is the sustainable siderurgy, an industrial branch without which the durable and sustainable development in Romania can not be imagined.

4. Conclusions

The information used to design research has shown that for the knowledge of the degradation (wear) of materials under special sociological, economic or legal conditions, the notions of obsolescence or obsolescăță (in Romanian) are recommended [8]. The further development of the research has shown that this recommendation is appropriate only for the first degrading situation analyzed in point 3.1.1. In reality, there are four situations that demonstrate that it is a much larger, more complex phenomenon involving many social strata, namely not only obsolescence obolescăță (in Romanian), but also moral degradation of materials and metal products.

This article aims to show that:
- In the metallic materials industry, it is possible to move from research based on specialized knowledge to research based on global knowledge;
- it is possible to move from the empirical approach (obsolescence) to the theoretical approach (moral degradation);
- new data and information contribute to strengthening the knowledge society;
- ensuring the dissemination of social knowledge among metallic material producers;
- The engineers of metallic materials are involved in the fight against the moral degradation of society.
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