MATERIALS AND CHECKING THEIR PROPERTIES

Gutnyk M.V.
National Technical University "Kharkiv Polytechnic Institute", Kharkiv, Kurpuchova 2; e-mail: maryna.gutnyk@khpi.edu.ua

The first information about materials testing is known to the mankind from the period of the Neolithic revolution. Some people began to improve their skills in finding the optimal properties of certain materials. As it known, the first material with which mankind became acquainted was copper. Metal tools became especially important in agriculture, where they significantly accelerated the land cultivation, and harvesting. It should be noted that it was in the manufacture of weapons that the properties of metals were used in the best way. Constant wars, the subjugation of tribes and peoples, the formation of a hierarchy of power, took place to a large extent thanks to the use of weapons made of copper-based alloys.

From the Ancient time became famous an experiment by Archimedes, who tried to find out the composition of the crown. At the end of the Renaissance, the knowledge of materials science developed quite actively. The most fundamental work on metallurgy can be considered "De Re Metallica" by Georg Bauer (1494–1555). The scientist developed the basics of chemical analysis, i.e., thanks to his refinement, the foundations of the first studies of various chemical compounds were laid. He described the technology of smelting and extraction of metals, considered the deposits of precious metals, the extraction of salt (real wars were fought over the control of salt deposits), sulfur, bitumen and glass.

In the 17th century, Galileo's Two New Sciences (strength of materials and kinematics) includes the first quantitative statements in the science of materials. According to manuscripts in 1595 was invented the first light microscope. Zacharias Jansen (1580–1638) of Holland invented a compound light microscope, one that used two lenses, with the second lens further magnifying the image produced by the first. It had a magnification that could be adjusted between 3 and 9x. Next step was the detection of *X*-rays. *X*-rays were discovered in 1895 by Wilhelm Conrad Roentgen (1845–1923) who was a Professor at Wuerzburg University in Germany. There is also another version – Ukrainian electrical engineer Ivan Puliui (1845–1918) in 1881 invented a special lamp, that was used *X*-rays for medical purposes. In 1913 the English physicist Henry Moseley (1887–1915) discovered a simple relationship between the wavelengths of the *X*-ray emission lines from a target and the atomic number of the target element – the wavelengths are inversely proportional to the square of the atomic number. Known as Moseley's law, this relationship proved to be a definitive tool in the determination of atomic numbers in the early days of atomic physics.

The earliest prototype of electron microscope, capable of four-hundred-power magnification, was developed in 1931 by the physicist Ernst Ruska (1906–1988) and the electrical engineer Max Knoll (1897–1969) at the Berlin Technische Hochschule or Berlin Technical University. At the same time new methods of materials testing began to used. Eddy-current testing (ECT). This type of testing has deep-time roots. They began largely instigated after Michal Faraday's (1791–1867) discovery of electromagnetic induction in 1831. In 1879 David Edward Hughes (1830–1900), demonstrated how the properties of a coil change when placed in contact with metals of different conductivity and permeability, which was applied to metallurgical sorting tests. Much of the development of ECT as a nondestructive testing technique for industrial applications was carried out during World War II in Germany. Professor Friedrich Förster (1908–1999) while working for the Kaiser-Wilhelm Institute adapted ECT to industrial use, developing instruments measuring conductivity and sorting mixed ferrous components.

The first infrared camera was built in 1929. It was a motion camera used by the British army for anti-aircraft operations following WWI. The military adopted the cameras quickly, and soon the technology was a vital part of defense strategy on both sides of the Atlantic. By the end of the 20th century, thermal imaging devices were much less expensive and became more accessible to consumers. They had applications in industries that include: building inspections, it is used to detect termites, check for roof leaks, and locate damaged pipes; medical diagnostics, it can detect the presence of inflammation, irregular blood flow, and some cancers; security, thermal imaging is used to confirm and validate the presence of people at a location, such as tracking illegal border crossings or securing rural or remote areas. In metal testing the infrared technology (as a non-destructive testing) used for inspecting of structural components, detecting weakened rivets, examining radar absorption structures and detecting cracks, breaks, etc. Its main disadvantage is that it is only effective in the detection of shallow defects. It is also difficult to produce a uniform heating to apply active techniques and there may be variations of emissivity in different parts of the studied body. Today there are different types of materials testing: abrasion and wear testing, aerospace fasteners, aircraft interiors flammability testing, chemical analysis, chemical processing, composite testing, computed tomography, contamination testing, corrosion testing, cyclic corrosion testing, die steel qualification, failure analysis, fatigue testing, foam testing, fractography services, fracture toughness, fuels and lubricants testing, hardness testing, liquid penetrant inspection, magnetic particle inspection, material properties, mechanical testing, metallurgical testing, nondestructive testing and inspection, nonmetals failure analysis polymer matrix composite testing, residual stress measurement, stress rupture and creep testing, etc. All of them are related to determining the properties of various materials, and information about their first application requires special historical research.