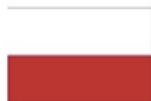




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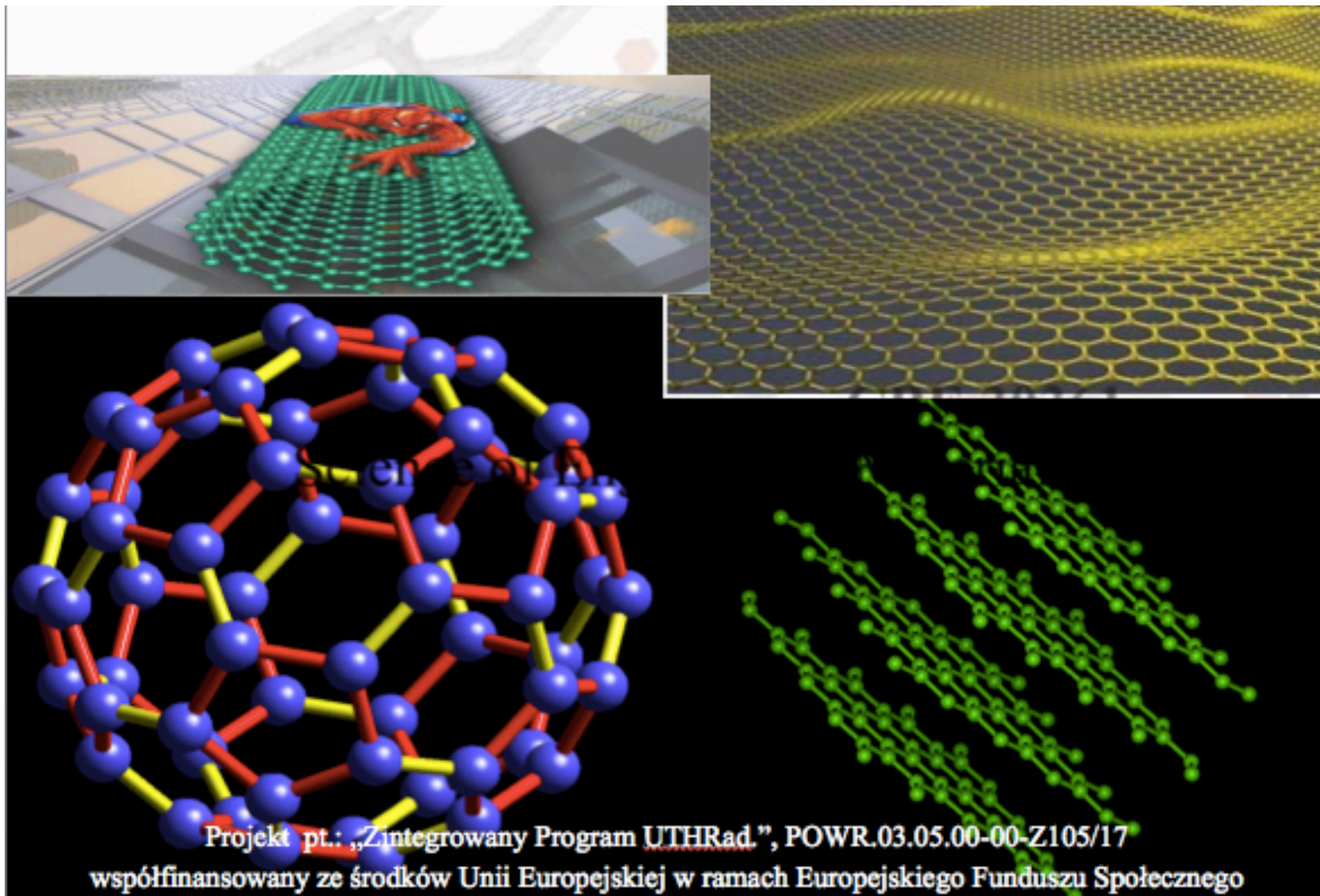


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UNIWERSYTET
TECHNOLOGICZNO-HUMANISTYCZNY
im. Kazimierza Pułaskiego w Radomiu

Unia Europejska
Europejski Fundusz Społeczny



Course Number:1

Course Title: Science of Engineering Materials

Lecture №06

Methods of obtaining and molding composite materials

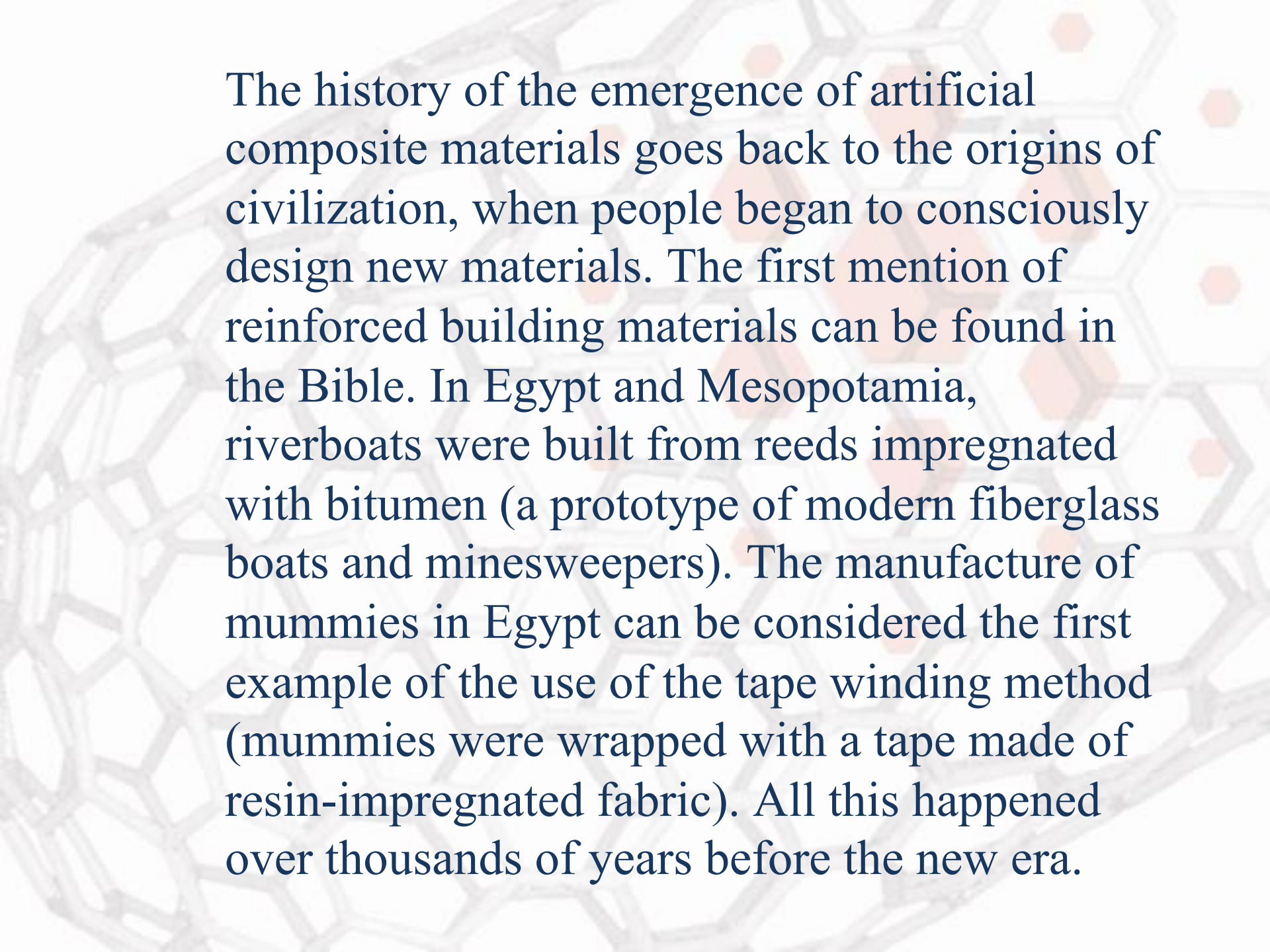
Instructor: Dr.prof.Edwin Gevorkyan

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E-mail: cermet-u@mail.com;

Website: www.cermet-u.com.ua

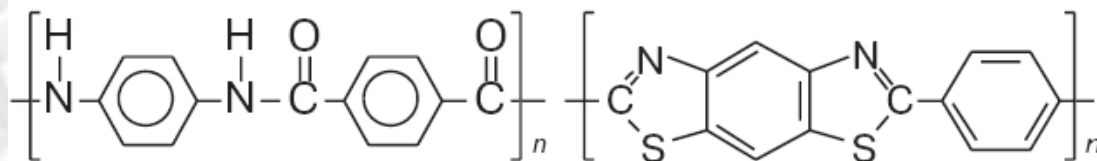
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The history of the emergence of artificial composite materials goes back to the origins of civilization, when people began to consciously design new materials. The first mention of reinforced building materials can be found in the Bible. In Egypt and Mesopotamia, riverboats were built from reeds impregnated with bitumen (a prototype of modern fiberglass boats and minesweepers). The manufacture of mummies in Egypt can be considered the first example of the use of the tape winding method (mummies were wrapped with a tape made of resin-impregnated fabric). All this happened over thousands of years before the new era.

Some polymer materials structure

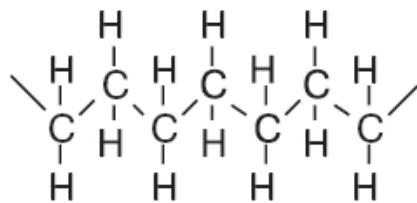
Жёсткоцепные полимеры



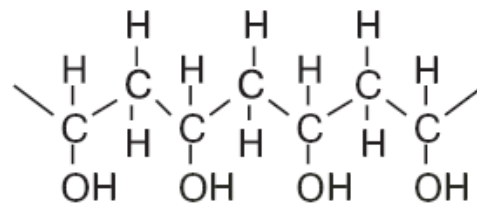
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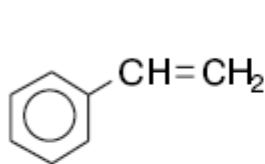
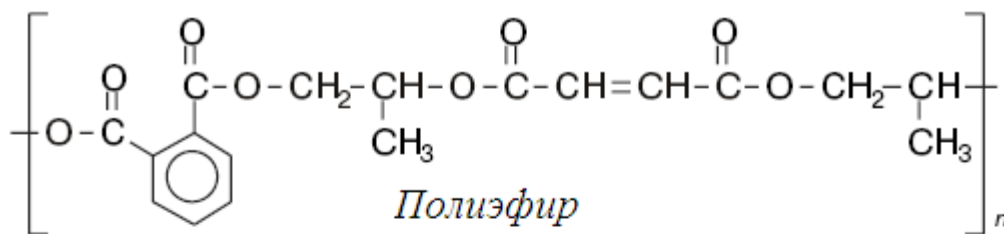


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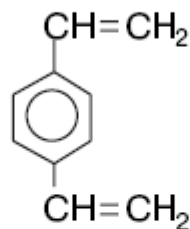


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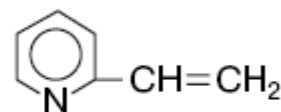
Chemical structure polyether polymers



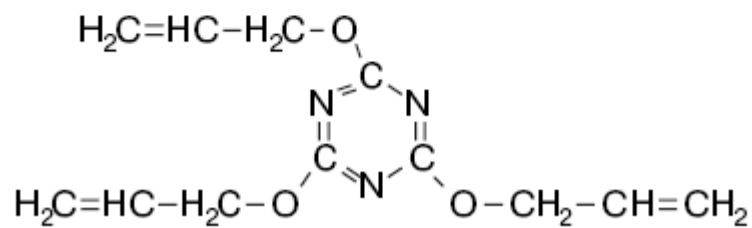
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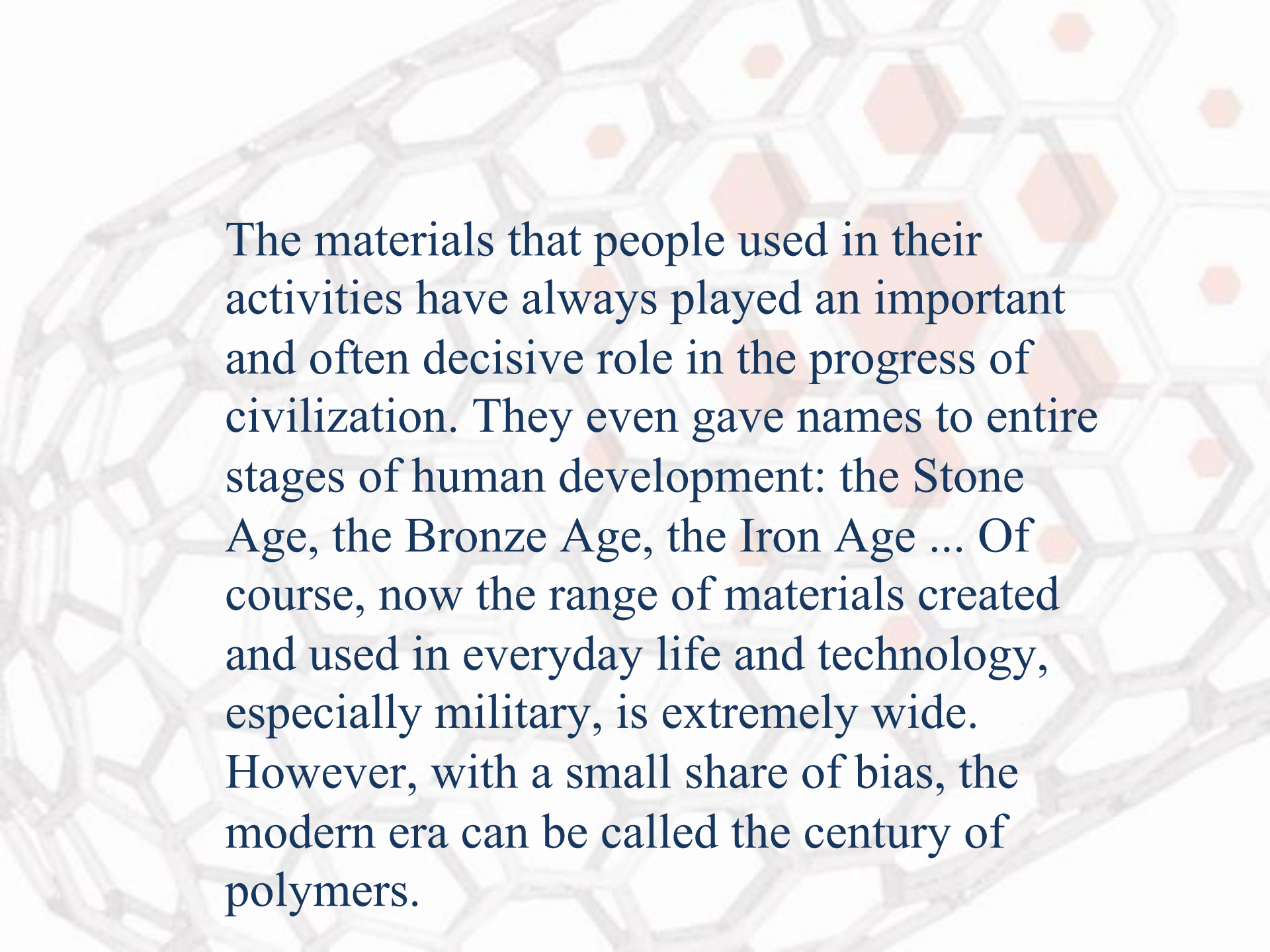
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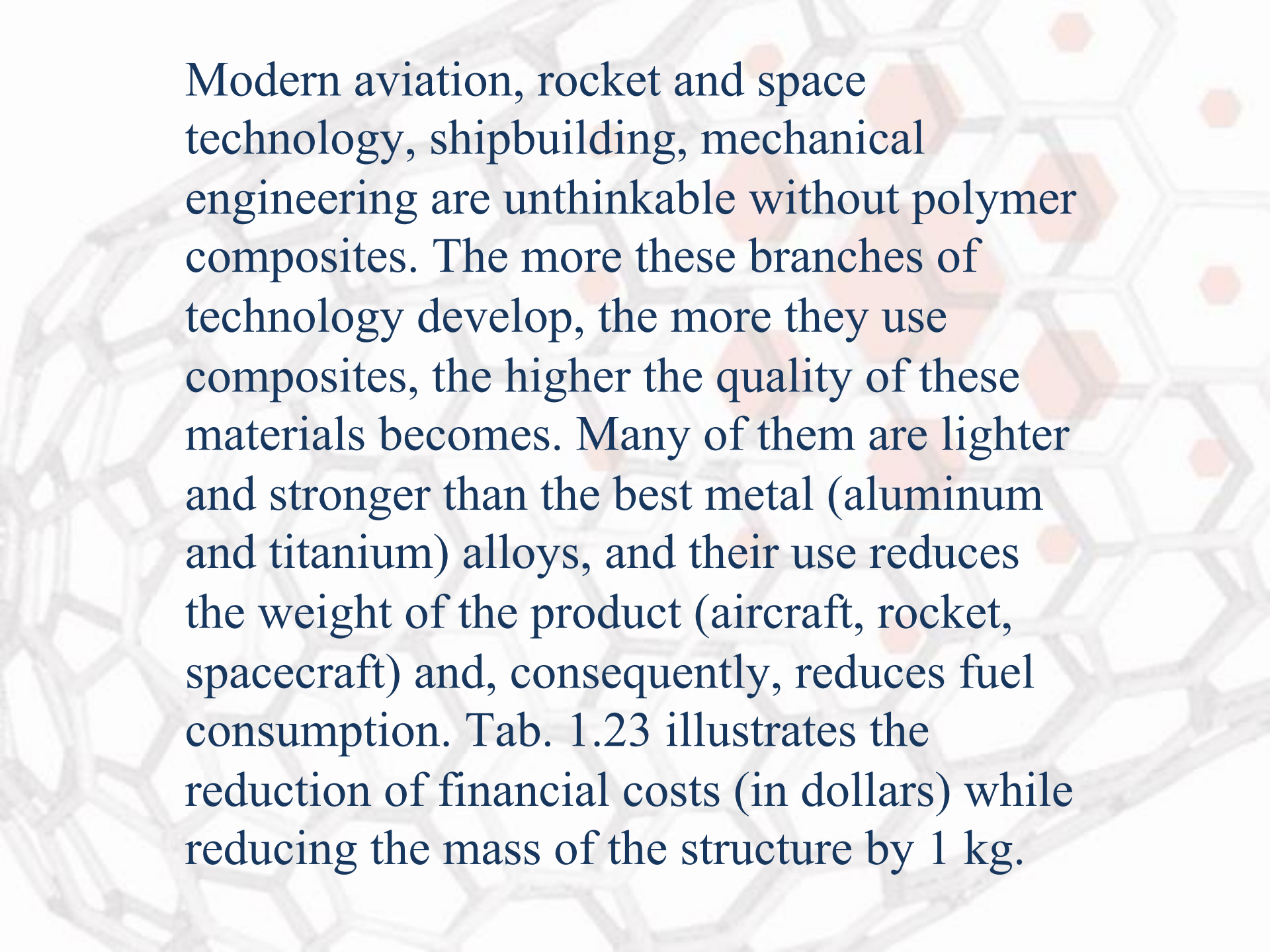
2-винилтиридин



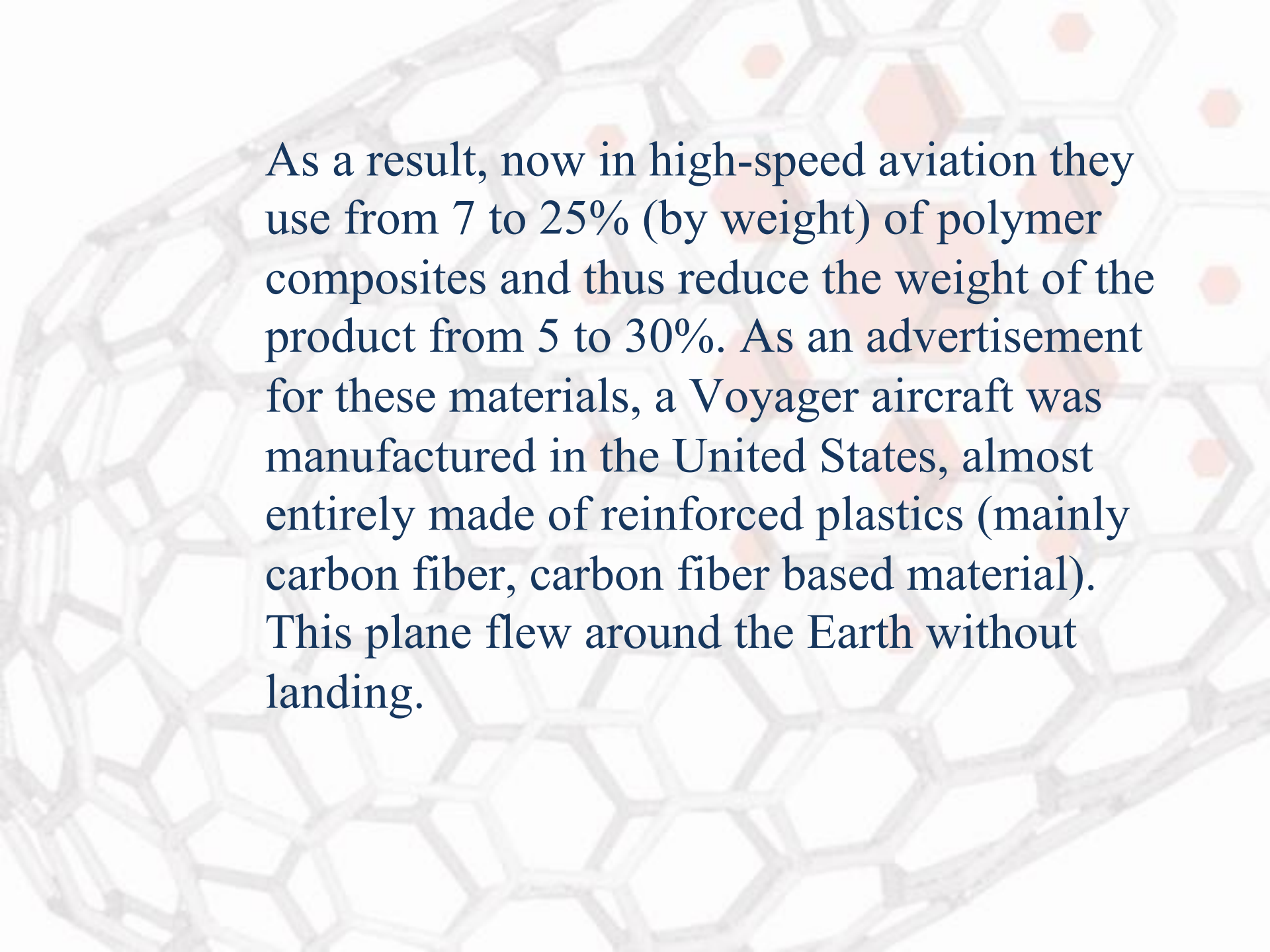
Триаллилцианурат



The materials that people used in their activities have always played an important and often decisive role in the progress of civilization. They even gave names to entire stages of human development: the Stone Age, the Bronze Age, the Iron Age ... Of course, now the range of materials created and used in everyday life and technology, especially military, is extremely wide. However, with a small share of bias, the modern era can be called the century of polymers.

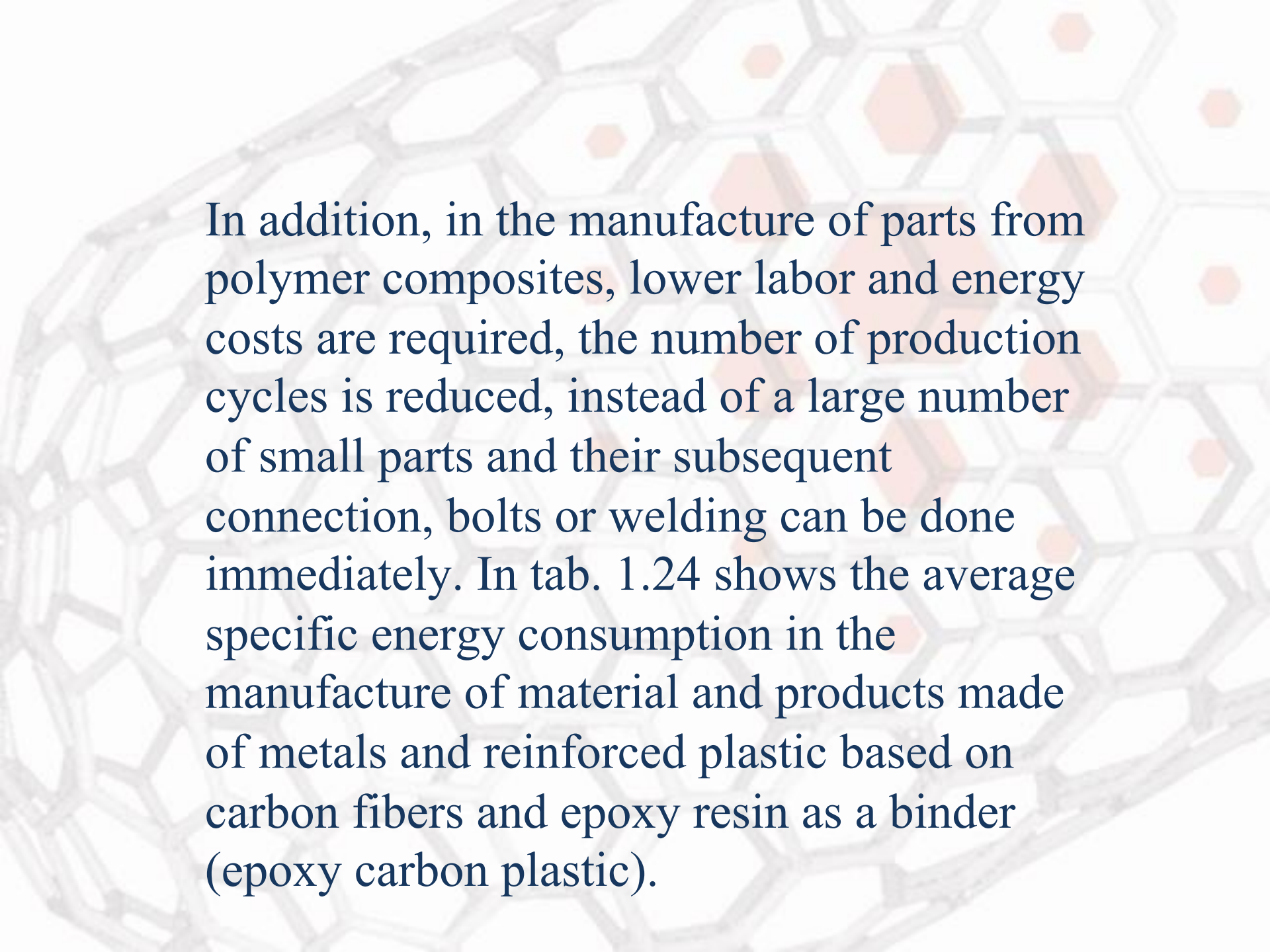


Modern aviation, rocket and space technology, shipbuilding, mechanical engineering are unthinkable without polymer composites. The more these branches of technology develop, the more they use composites, the higher the quality of these materials becomes. Many of them are lighter and stronger than the best metal (aluminum and titanium) alloys, and their use reduces the weight of the product (aircraft, rocket, spacecraft) and, consequently, reduces fuel consumption. Tab. 1.23 illustrates the reduction of financial costs (in dollars) while reducing the mass of the structure by 1 kg.



As a result, now in high-speed aviation they use from 7 to 25% (by weight) of polymer composites and thus reduce the weight of the product from 5 to 30%. As an advertisement for these materials, a Voyager aircraft was manufactured in the United States, almost entirely made of reinforced plastics (mainly carbon fiber, carbon fiber based material). This plane flew around the Earth without landing.

It is also important that waste in the manufacture of parts from polymer composites is no more than $10 \div 30\%$ of the material, while similar parts from high-strength aluminum and titanium alloys used in aviation can waste $4 \div 12$ times the mass of the product . The experience of using polymer composites has shown that the maximum gain from their use can be achieved only by creatively designing an aircraft or other product, taking into account the peculiarities of the properties of reinforced plastics and their manufacturing technology.



In addition, in the manufacture of parts from polymer composites, lower labor and energy costs are required, the number of production cycles is reduced, instead of a large number of small parts and their subsequent connection, bolts or welding can be done immediately. In tab. 1.24 shows the average specific energy consumption in the manufacture of material and products made of metals and reinforced plastic based on carbon fibers and epoxy resin as a binder (epoxy carbon plastic).