Energy from the sea

Energy from the waves

Theoretically it is possible to convert at least five types of energy that are present in the sea: the current, the waves, the tides and the thermal gradient (temperature difference) between the surface and the floor.
At the moment there is only one power plant that exploits tides in France, while experiments are being made to exploit wave energy potential in the UK, in Norway and Japan and the thermal gradient in the United States. The European Union has just concluded a study that identifies almost 100 sites that could be used to produce electric energy from sea tides. In Italy the strait of Messina has been defined as one of the most promising sites.

Energy from the waves

The idea of exploiting the waves to obtain electric energy, although it creates some problems, stimulates engineers' fantasy. Researchers are trying to concentrate the waves in order to increase their height and their potential conversion into electric energy.
Other attempts try to use pressure variations that occur under the sea; some others use floats that "replicate" the wave motion and convey it to the generators by means of hydraulic pistons.

Energy of tides

We all know the strong pull of the Moon on water. From the regular raising and lowering of water mass it is possible to obtain energy. In order to build a tide-based power plant the estuary is barred towards the sea with an artificial damn. The energy technique exploits the difference in height between high and low tide: the so-called amplitude of tide. Obviously the amplitude of the tide has to be sufficient, as it happens in Northern France, close to Saint Malo, where the difference between the minimum level and the maximum level of the water is 12-13 metres. Right from Saint Malo to Dinard, on the Channel, at the mouth of the Rance River, the world's first tide-based power plant has been active since 1966. It is the Rance Tidal Power Station, which has a power of 240 MW.

Sea current and tide energy

Tidal power is one of the most interesting and unexplored sources of renewable energy. It must be noted that in Europe alone, the availability of this type of energy is equal to approximately 75 gigawatt (75 million kilowatt). As it is known, besides the power, what is important is the estimate of the energy that can be exploited: in Europe this amounts to approximately 50 terawatt (terawatt hour equivalent to 50 billion kilowatt hour).
In 2003, for the first time a project was realized for the exploitation of this energy in Hammerfest, a town on the northern coast of Norway. The inhabitants of this remote town, who do not see the sun for long periods of the year, and whose geographic position is not so suited for connections to the traditional sources of energy, seem to have solved the problem. The blades of the turbine are 10 metres long and turn when the tide rises in the Kvalsund strait, and stop when the seawater reaches its maximum level. They then start moving in the opposite direction when the tide begins to fall. According to estimates, approximately 700,000 kilowatt hour of non-polluted power should be generated per year (even though production costs are higher), which is enough to guarantee light and heating to about thirty homes.
The turbines to exploit the sea currents can be (as in the case of wind technologies) either horizontal-axis or vertical-axis turbines. Horizontal axis turbines are more suited in the case of constant sea currents, as in the Mediterranean, while vertical axis turbines are more suited for sea currents, because they can change direction by approximately 180 degrees a number of times in a day.

Energy from thermal gradient

The first power plant for the conversion of ocean thermal energy was created in 1996 offshore the Hawaii islands and produces energy exploiting the temperature difference between the different layers of the ocean. The solar energy absorbed by the sea surface heats it, creating a temperature difference between the surface water, whose temperature is

around 25-28°C, and deeper water, up to 600 m depth, and whose temperature does not exceed 6-7°C.
Superficial water, which is warmer, lets substances like ammonia and fluoride evaporate. High-pressure vapours activate a turbine and an electricity generator; they pass into a condenser, go back to a liquid state and are cooled down by the water, which is sucked from the bottom. A 20°C difference is sufficient to guarantee the production of an economically exploitable quantity of energy. At the moment there is a power of 50 kW/h, but it will probably be possible to reach 2 MW even though the costs are very high. (Many abandoned sea platforms for the extraction of hydrocarbons could be converted for the application of this technology).