The analysis of oil refining costs at Angarsk Petrochemical Company (PCC) indicates that the most important item is the cost of power. According to the operating results for 1998, power consumption accounted for 20.6% of total production costs.

The following structure of consumption of fuel and energy resources (FER) is characteristic of the refinery: thermal energy: 80%, electric power: 14%, fuel: 6%. As follows from this structure, the share of thermal energy is the most important, so that reducing it is a priority in saving FER.

The refinery obtains most of its heat in the form of steam and power-and-heating water from an outside source — the heat and electric power plant (HEPP) located in the immediate vicinity. The monthly consumption in heat is on average 798 TJ in winter and 546 TJ in summer. Up to 25% of consumption is covered by heat produced in-house.

The problem of reducing energy consumption is solved in several directions: economic consumption of energy resources; use of secondary energy resources; in-house production of heat, which is less expensive than heat manufactured at HEPP.

SAVING ENERGY RESOURCES

Optimization of steam consumption by the vacuum resid deasphalting unit is an example: it was possible to reduce steam consumption by more than 30% (from 56.7 to 42 GJ/h) as a result of the many measures instituted.

The method of calorimetric definition of equipment and heat exchangers utilizing steam as a heating agent showed that the amount of uncondensed steam in many heat exchangers is greater than 30%. Thermal calculations to determine steam consumption for each unit and the installation as a whole confirmed this finding. To ensure total condensation of steam in the propane evaporators, the condensate collection circuit was redesigned.

The basic cause of underutilization of steam condensation heat is removal of condensate from a group of heat exchangers of the same kind parallelly connected to the common steam separator according to product (Fig. 1a). The uncondensed steam passes into the separator due to the different load of the heat exchangers in product caused by the hydraulic deployment scheme and the different degree of contamination of the heat-exchange surface.

Small vessels with condensate level gages and regulators were installed to ensue total condensation for each heat exchanger (Fig. 1b), and this allowed totally automating the heating process and reducing consumption of the energy carrier. The total costs for installing these devices are no higher than the cost of imported steam traps on large heat exchangers.

Experience in utilizing heat exchangers with steam traps demonstrated the complexity of controlling the efficiency of operation of the steam traps and the necessity of periodically testing them on special benches. In using intermediate condensate vessels, separation of the media can be constantly monitored with the proposed system.

It was also possible to perceptibly reduce steam consumption by introducing such systems for removing condensate from large heat exchangers in other installations.
USE OF SECONDARY ENERGY RESOURCES (SER)

The refinery has traditionally used heat from process furnace stack gases for steam production in waste-heat boilers and heating of furnace burner air. In addition, it has experience in utilizing the heat from hot petroleum products. A system of an autonomous circuit for heating and warming process equipment and pipelines with this heat was introduced in the AVT-2 installation.

The process scheme of this installation provides for removal of vacuum distillate used as feedstock for production of oils with cooling from 160 to 80°C. Cooling takes place in a heat exchanger with recycled water. The calculated amount of heat removed from the water should be 9.42 GJ/h. This system allows almost totally utilizing this heat for heating the aqueous heat carrier.

The principle of operation of the system (Fig. 2) consists of the following: water from the return pipeline of the refinery’s industrial power-and-heating circuit, used for heating pipelines and equipment, is pumped through the heat exchanger where it is heated by the heat of the cooled petroleum product in accordance with the temperature graph of the refinery’s industrial power-and-heating network. The heated water enters the manifold of satellites and the heating and forced ventilation system of the installation. The heating temperature is regulated based on the flow rate of the industrial power-and-heating water in the refinery’s network as a function of the temperature of the water at the outlet of the heat exchanger.

In addition to saving thermal energy, this system reduces consumption of return water for the installation and increases the pressure differential between the forward and reverse pipelines for the power-and-heating water, thus increasing the reliability of water satellites.

Similar systems were developed after the necessary calculations for a series of other units in the refinery. It will become possible to effectively utilize another 33.6 – 42 GJ/h of SER heat.

PRODUCTION OF THERMAL ENERGY

A program to increase in-house production of cheap thermal energy is being implemented in the refinery. The first step in this program was to introduce a steam production system in the hydrogen production