

Ecology. Ecological and meteorological problems of cities and industrial zones

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Tire Utilization

From year to year the number of cars increases and the number of used tires increases as well. Worn-out tires are the source of the long-term contamination of the environment; they are treated as the wastes of danger class IV and are subject to the obligatory utilization / recycling. There are about 25 million of tons of used tires in the world now. Their number annually increases by 7 million of tons. As it had been estimated by the Ministry of Environment of Ukraine the problem of waste tire utilization in Ukraine has reached a wide scale: every year about 180000 ton of used tires are thrown away. They are stored in the forests, fields, along the roads or burned. About 270 kilograms of soot and 450 kg of toxic gases come into the atmosphere during the burning of 1 ton of used tires as well as such dangerous substances as benzopyrene, soot, dioxins, furans, polyaromatic hydrocarbons, polychlorinated biphenyls (PCBs), chromium, arsenic, cadmium, etc.

That all shows big opportunities of waste utilization for tire recycling by means of pyrolysis and valuable materials recovering such as pyrolysis gas, synoil, carbon black, metal cord.

Scheme of the tire recycling is shown on the Fig.1

Used tires are collected and delivered to the raw material storage. Tires are examined for the presence of metal disks, rings and sent to the cutting. In order to provide denser piling of raw materials into the retort the tires can be cut. At first tire bead is cut and then the tire is carved with the help of special scissors for tire cutting.

Whole or cut pieces of tires are loaded into retort (basket) after that the retort is put into the pyrolysis installation (reactor) with the help of telfer or other lifting mechanism. There it is heated up to 500°C with no access of oxygen (pyrolysis process).

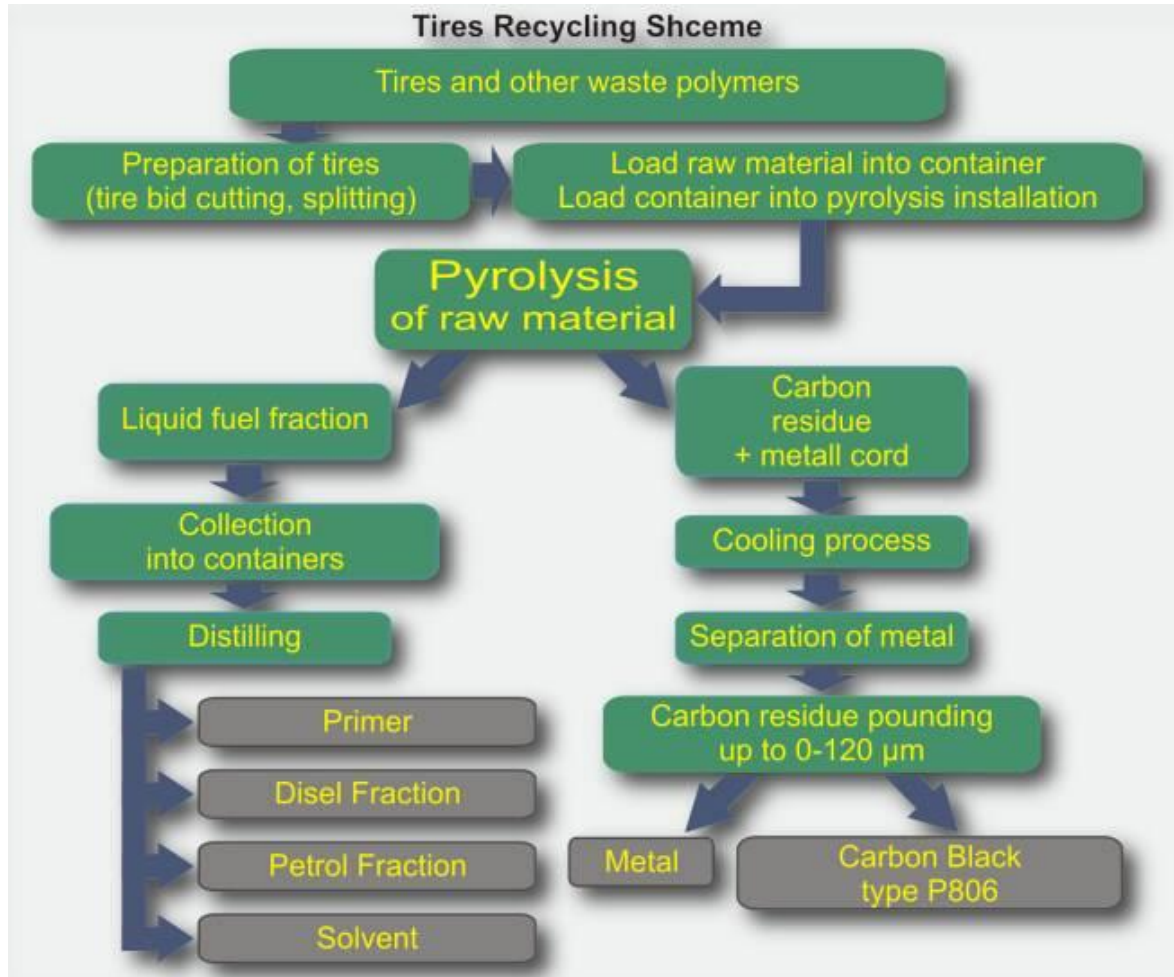


Fig.1

Initially the installation is heated with the help of additional fuel; home-made products (carbon residue (semi-coke), liquid fuel fraction, pyrolysis gas (methane)) can be used for this purpose. After the 2-3 hour mode is achieved additional fuel is not used, the gas jet, working on non-condensed residues of pyrolysis products, is activated instead. In the result of the pyrolysis process gas and steam mixture is obtained. The mixture is directed into the condensation system (rectifying column). After rectification the residues of gas and steam mixture are burned down in liquid fuel gas jet which ensures the process maintenance. As a result of condensation liquid fuel fraction called synoil is obtained.

As the pyrolysis process is exothermal reaction followed by heat release, extra pyrolysis gas similar to methane is obtained. It can also be used profitably. The duration of the process makes 10-11 hours taking into account that 0, 5 t of tires are loaded into the retort. When the process is over which is indicated by the control and measuring apparatus and by termination of gas emission, the pyrolysis installation is opened with the help of telfer and the retort is taken out, sealed and moved to cool down.

In its turn another retort with raw materials is loaded into the vacant pyrolysis installation after that the process continues.

After the full cooling action (10-12 hours) carbon residue and metal cord can be moved from the retort. Then metal cord should be separated from carbon residue. It is possible to use the mechanized way of separation. In order to do this the contents of the retort are loaded into a cellular basket which is installed into the sieving machine, where the separation of carbon from metal cord takes place. Fine pieces of metal are removed with the help of magnet separation. After sieving machine we obtain clean metal cord and also black carbon ready for the further processing.

Products obtained by recycling are subject to further processing for additional profit. So carbon residue is ground and marketed as carbon black. Liquid fuel fraction is subject to sublimation for fractionation into diesel, bituminous, petrol and other ones.

Technology benefits:

- No harmful emissions are discharged into the atmosphere;
- Convenient way of raw materials loading/unloading;
- Separation system of metal cord from carbon black is automated;
- Carbon residue can be used for further processing;
- High yield of liquid fraction;
- Rectification of liquid fuel fraction;
- Safe construction of the installation;
- Continuous process.

Economic benefit from 1 unit of our pyrolysis installation (tank) is 170-440 USD per day.

1 ton of waste tires can be converted into: pyrolysis gas - 100 m³; synoil- 350-400 kg; carbon black - 250-300 kg; metal cord - 200-250 kg.

Income items from installation

Carbon black, containing 92-99% of pure carbon, is directed to the refining in the technological process. This results in obtaining of carbon-carbon materials for metallurgy and/or electro conductive carbon black. Consumption range: carbon-carbon materials for metallurgy, manufacture of synthetic diamonds, stationery, alternator brushes, chemical current sources, conductive screens of shaft cables, as a filler of the rubber-containing products and etc.

Synoil is very similar to natural oil. The main components of it are: diesel, petrol, bituminous fraction. It can be used as stove fuel or as black oil; additive for DO - 37% (its price is 25% lower than the price of diesel gas oil), additive for petroleum - 33%; its octane number is 130, primer (rust-preventing agent) - 30%. The price for synoil in the Ukrainian market is 0,3-0, 4 USD/l. After distillation the obtained products are sold at the price from 0,6 to 1,2 USD/l.

Gas is one of the strategic raw materials for Ukraine. It can be used for the operation of mini boiler stations. 100 m³ of gas is obtained from one boiler, but only 50 m³ of gas is used for the in-house needs (operation of 80 kW gas jet within 9 work hours).

Metal cord is sold as scrap metal or as binding wire after burning. The price for it makes 0, 15-0, 5 USD/kg.

Collection of tires for recycling. In average the prices in Ukraine make 0, 3-0, 6 USD/pcs. for light tires, 0, 6-1,2 USD/pcs. for trucks tires or 50 USD/t.

Literature:

1. <http://www.biodiesel-ua.com>
2. <http://www.greenpower.com.ua>
3. <http://www.piroliz.com.ua/>
4. <http://www.superbusiness.com.ua>