**Plastic Waste Catalytic Pyrolysis in a Reactive Semi-Batch Distillation**

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**Highlights**

* The use of the ZSM-5 catalyst caused a significant increase in the gas and liquid fractions of products.
* Increasing the temperature, the gas and liquid formation increased, and solid yield decreased.
* The composition of liquid formation, in catalytic pyrolysis, was mostly in the range of gasoline.

**1. Introduction**

The generation of plastic waste is constantly increasing. In the context of processing waste from electric and electronic equipment (WEEE), recycling plastics from electric cable waste has attracted increasing attention in recent years. Although the priority is generally given to the recycling of the conducting metal, due to its higher value, large amounts of plastic from electric cable waste are released into the environment without an effective disposal [1]. This incorrect disposal causes great problems to the environment, since, plastics (part of electric cable) are not easily degraded and remain in the environment for a long time if disposed in a landfill [2]. A large part of this waste may also be incinerated [3]. New processes are needed to increase the percentage that is recycled. The use of feedstock recycling, for example by resorting to pyrolysis may be an attractive alternative. It allows us to obtain a broad distribution of products, including char, oil/wax and combustible gases from plastic wastes [4]. In this work, the influence of temperature on the catalytic pyrolysis of the electrical cables waste (ECW) will be analysed.

**2. Methods**

The ECW were provided by Pyroplas. The samples were washed and crushed into coarse grains. The catalytic pyrolysis experiments were carried out using an unstirred glass distillation reactor in semi-batch operation at atmospheric pressure. The catalyst used was a ZSM-5 and ratio catalyst/plastic was 1%. The reactor was initially flushed with N2, then about 10 g of the plastic waste material were placed in the reactor which was heated at 10 °C min-1 to a final temperature ranging from 450 to 500°C. The final temperature was maintained for 90 min. On top of the reactor there is liquid collection vessel below the condenser where the coolant water was fed at 20 °C to control the product that escaped into the gaseous phase. The gases that escaped the condenser were collected in a gas-burette.

**3. Results and discussion**

The mass yield of the products obtained for catalytic pyrolysis are described in Figure 1, for the three temperatures studied the reaction time was 90 min after reaching the final temperature.

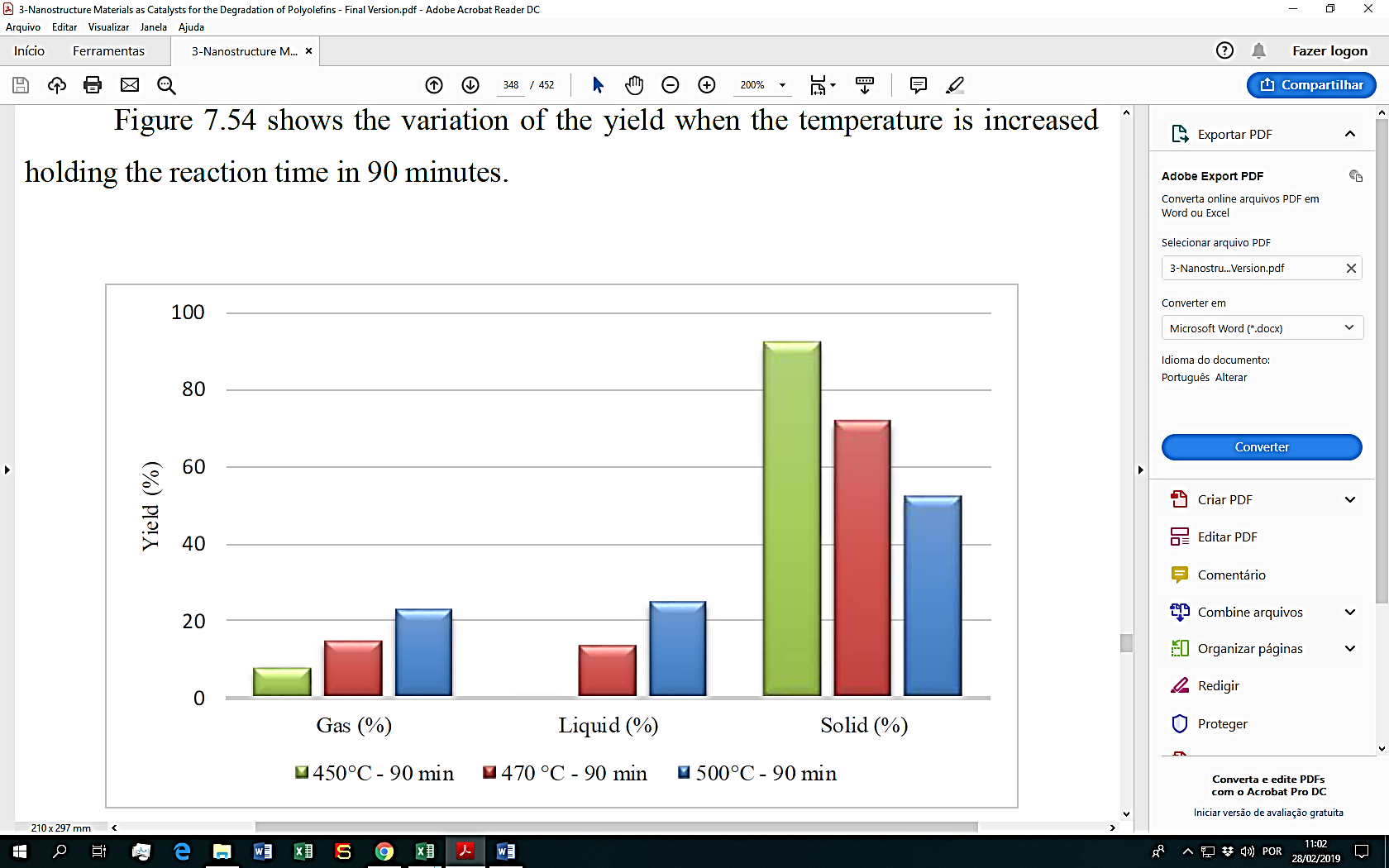


Figure 1: Variation of the yield of products for catalytic pyrolysis of ECW at different temperatures.

It is observed from the results of Figure 1 that the largest amount of products formed is in the solid phase (wax), results which are in accordance with Chaala [5]. For the lowest temperature (450 °C) it was not possible to collect any liquid phase products. It is important to note that the increase of 50 °C in the system did not cause any significant changes in the yield of the products in the liquid and gaseous phase.

The distributions of the products collected in the gas and liquid phase for the catalytic pyrolysis are shown below in Figures 2a and 2b respectively. The wax products obtained were also characterized by TG/DSC.

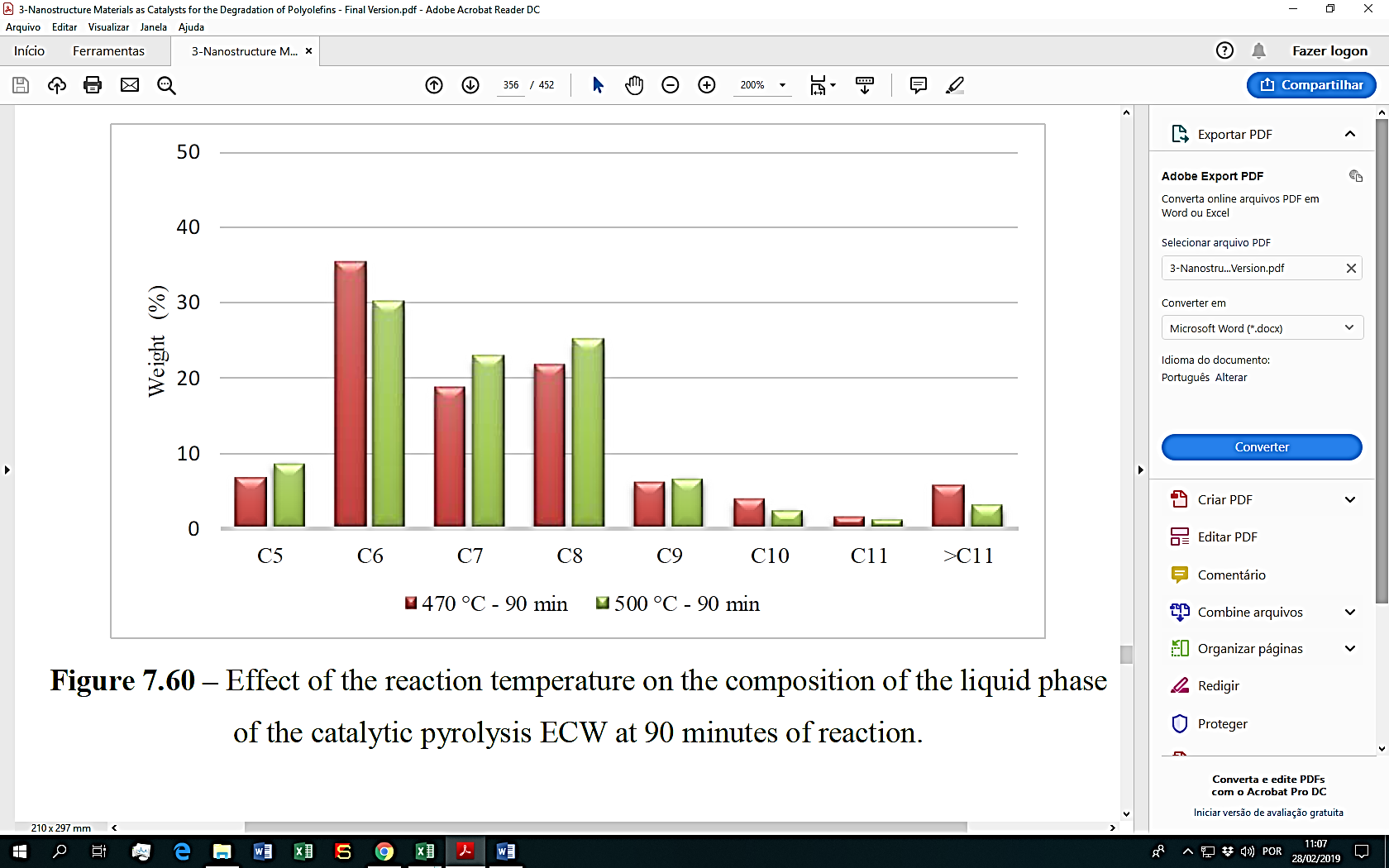
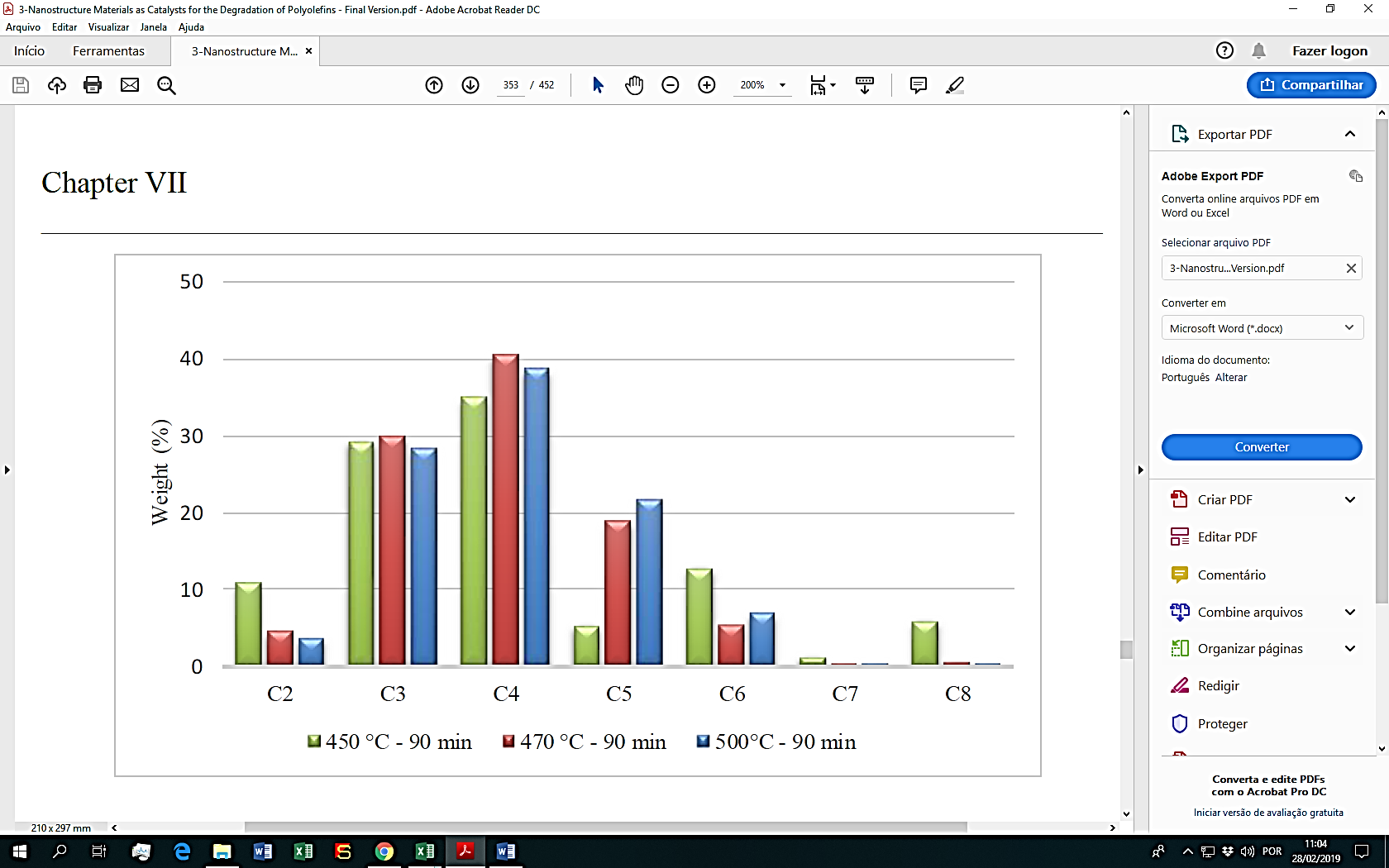


Figure 2: Product distribution (a) Gas phase and (b) Liquid phase.

**4. Conclusions**

The reactive distillation system was able to reach around 50 % conversion into liquids and gases. Increasing the temperature, the gas and liquid formation increased, and solid yield decreased. The gas phase has a composition in the range from C2 to C8. It is possible to observe that the increasing the temperature there was an increase of C4 and C5 formation and decrease C2 and C6 formation. Heavier fractions of the gas products (C6-C8) were converted into the light products with the increase in temperature of 50 °C in the set-point temperature, which evidences the increase in the C5 for this variation. In liquid phase, the increase of temperature, caused a decrease of the heavier compounds formation (> C11) and increase production of the components of C5, C7, and C8.

**References**

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