Thermal degradation and tensile strength of sansevieria trifasciata-polypropylene composites

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Abstract. The paper exhibits thermal degradation and tensile strength of Sansevieria Trifasciata (ST) fibers and polypropylene (PP) composites. Thermal degradation of ST fibers PP composites was conducted by using thermogravimetry (TGA) instrument, meanwhile tensile strength of the composite was done by using tensile equipment. The results show that the thermal resistance of ST fibers PP composites was higher than that of virgin PP only. Increases in volume fraction of fibers in the composites enhance the tensile strength. Scanning Electron Microscope (SEM) observation exhibits good interface bonding between ST fibers and PP matrix.

1. Introduction
Natural fibers still provided a great attention of researcher communities to be developed being a new material having interesting properties. Combination between natural fibers and polymers resulted in some kinds of alternative substance. Even, the compounds of both materials provided better properties in comparison to other conventional materials like steel. Natural fibers have special advantages in cases of light weight, renewability, low price, environmental friendly [1].

Indonesia as tropical country provided huge types of plants. One of those is ST plant growing very easy and fast. They have interesting properties like high mechanical properties, low density and small diameters [2]. As reported by last study that characterization of natural fibers depends on growing location like temperature, humidity, elements in ground [3]. Aim of the study is to research properties of individual ST fibers growing in local area, Indonesia, as well as their effect on PP matrix composites.

2. Methods

2.1. Extraction the ST fibers and composites
The ST fibers were extracted from leaves of local ST plant growing in Padang, Indonesia. Steps the extraction of the fibers from a ST leaf, in detail, were reported in Final Project Kenedy E [4]. The extracted ST fibers were then treated by 5% NaOH solution for 30 min. The treated, cleaned, dried ST fibers were cut, 5 mm long, and distributed between PP sheets with fibers fraction of 2%. Composite samples were made by hot press machine at 150°C, for 20 min by 20 ton in load. Preparation the samples for tensile testing was based on ASTM D638.
2.2. Thermogravimetric
Equipment used for measuring degradation of composites while increasing temperature was TGA Q500, a product of TA Instrument. Temperature rate was 20°C per min. from range of temperature 20 up to 1000°C. Nitrogen rate flown during experiment was 40 ml per min.

2.3. Tensile testing
Equipment Com-Ten testing machine of 95T Series was used for measuring tensile strength of composite sample. Speed and temperature during testing were 3 mm/min. and room temperature, respectively.

2.4. SEM observation
Fracture surface of ST-PP composite was observed using SEM photographs. Kind of SEM was a Hitachi 3400 N series equipment.

3. Results and analysis

3.1. Thermal properties
Figure 1 shows thermal degradation of research sample against increase in temperature. Sample in figure 1(a) was pure PP degraded while raising temperature. Meanwhile, Figure 1(b) exhibited thermal properties of 2%ST-PP composites. It is clear to see that both figures showed different characterization. Virgin PP sample has no higher resistance on increasing temperature in comparison to ST-PP composites. Similar result of last study was also reported by Chen, et al [5] that pure PP was only in one stage, meanwhile composites samples exhibits thermal behavior in two steps as raising temperature. The different step of both samples was due to different chemical composition [5].

3.2. Tensile strength of ST-PP composites
Figure 2 shows effect of filler on tensile strength the composites. ST fibers were applied as filler in between PP sheet as matrix component. ST fibers have been treated with sodium hydroxide of 5% for 30 min. In this paper only limited ST fibers fraction was reported. The results can be observed in figure 2 in which tensile strength of the composites increases in rising ST weight. As reported in last studies, enhancement of the mechanical properties was due to external load distributed affectively to ST fibers [6].

3.3. SEM photographs
Figure 3 shows SEM observation on fracture surface of pure PP as well as composites. In the figure 3(a), there is no void, micro crevice observed on the surface, hence, all thin sheets of PP was well fused. Figure 3(b) exhibited fracture surface of the PP-ST composites in which the fibers were bonded
by PP matrix. No gap between ST fibers and PP sheets was seen as indication better interface bonding both substances. This result was a good agreement with last studies [7, 8]. Therefore, a good bonding from these components in making composites provided increasing tensile strength as shown in figure 2.

Figure 2. Tensile strength in MPA of PP only as well as 2% ST-PP composites.

Figure 3. (a) SEM surface of PP only; (b) SEM surface of 2%ST-PP matrix.

4. Conclusion
The paper informed the thermal properties of PP only as well as tensile strength of 2%ST-PP composites. Some conclusions may be explained that 2% ST fibers in PP matrix have increased thermal properties in comparison to PP only. PP was degraded in one step in increasing temperature, meanwhile, composites with 2% ST fibers showed two steps in thermal degradation. Tensile strength of PP composed by 2% ST fibers is higher than that of PP only.

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