RECYCLED JUTE NON-WOVEN SORBENT MODIFIED WITH FATTY ACIDS FOR OIL CLEAN-UP

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Abstract: Growing volumes of textile waste and frequent oil spills on water surfaces pose a serious environmental threat, which requires urgent action and efficient, environmentally and economically feasible solutions. Many efforts have been made to utilize textile fibers in loose form for cleaning of oil spills, but the fact that loose fibrous assemblies cannot be simply separated from the spill after use, makes such approaches impractical. To address this, a non-woven sorbent (NWS) made of recycled jute fibers from carpet industry was fabricated by needle-punching. The influence of NWS area density (Figure 1, NWS1 - 400 g/m^2 and NWS2 – 530 g/m^2) on buoyancy, sorption capacity, oil retention and reusability were investigated. The sorption behavior was investigated by testing four oils of different viscosity (crude oil, diesel oil and two motor oils). The experiments were performed in water and oil without water. In order to study the influence of fiber surface hydrophobicity on oil sorption behavior, jute fibers were esterified with stearic and lauric fatty acids.

Efficient sorbent is expected not to sink, but instead to stay afloat even when being saturated with oil and water. NWS1 and NWS2 passed a 15 min long buoyancy static/dynamic test and a 24 h long static test in water independently of area density. However, NWS2 with larger area density were waterlogged and these samples are not recommended to stay longer in water.

Oil sorption capacity was highly affected by NWS area density and oil viscosity (Figure 2). Smaller oil uptake was achieved with NWS2 likely due to its more compact structure and lack of voids where oil could be trapped. Diesel oil with the lowest viscosity was sorbed the least and the influence of NWS area density was less prominent. Considerably larger sorption capacities were achieved with higher viscosity oils. Oil sorption was more efficient on NWS1 because of their looser structure. Very similar sorption capacities were obtained when the sorption was carried out in water and oil alone. At the same time, the esterification did not induce any significant influence on oil sorption capacity, particularly in the case of more compact NWS and sorption of diesel oil.

Although NWS2 initially sorbed smaller amounts of oil, it provided much better oil retention. In contrast, less compact NWS1 showed larger oil dripping because they could not hold the oil in voids between the fibers and destabilization of oil capillary bridging between fibers occurred. The retention of higher viscosity oils was more difficult and hance, diesel oil retention on all investigated NWSs was the largest.

All studied NWSs retained around 50% of initial oil uptake after 5 repeated sorption cycles. NWSs were squeezed between rollers after each sorption process and it is believed that this mechanical action deforms the structure of NWS leading to reduction of voids between fibers available for oil sorption. On the other hand, the decrease in oil uptake can be also attributed to oil trapped inside the fiber lumen and voids partially filled with oil.

Keywords: *jute, recycling, fatty acids, oil.*

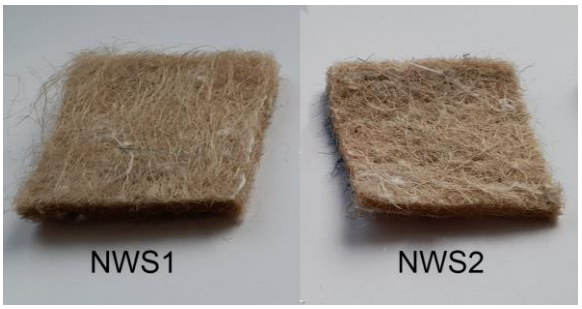

Figure 1 Jute non-woven sorbents of different area density

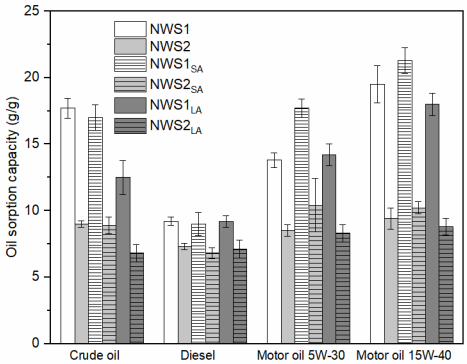

Figure 2 Oil sorption capacities of jute non-woven sorbents in aquatic medium (indices SA and LA denote NWS esterified with stearic and lauric acid, respectively)

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