Summary

Woodchips, wood pellets, and especially BO_2 become more important in the future for the production of energy. It can substitute fossil fuel resulting in a net reduction in greenhouse gas emissions. The primary objective of this work was to determine the angle of repose, moisture content and the time consolidation of pellets and woodchips. The secondary objective was to find relations between these properties. Three different types of particle sizes of woodchips ranging from 0 – 20 mm, 0- 40 mm and 0- 100 mm were used. For the wood pellets three different numbers of sizes and physical properties are used namely: 6mm, 8mm and 12mm. These are made from compacted sawdust or from demolition wood and are made in a pellet mill with three different holes. BO_2 is a pellet that undergoes a thermo chemical treatment which is also known as torrefection. Torrefection gives an increase in density and improve its hydrophobic properties. The BO_2 pellets can be made of different types of biomass.

For the angle of reposes and time consolidations there were no specifications of the test method on hand. The moisture content can be measured to follow the CEN/TS 14774-1:2004 method. The angle of repose is measured by the loose-base method [8]. To determine the angle we used three different methods. The first method was the average of four angles of the pile measured with a protractor. The second method was to measure the base periphery and the vertical height of the cone and then calculates the angle of the pile. The last method is the same as method 2, but instead of a perfect cone we now get a cone which is flatted. The time consolidation experiment has to be set up for the large particle sizes with different stresses in which will be encountered in practice. Consolidation is a process where the biomass decreases in volume by an applied pressure. The consolidation is measured by the difference in height over fourteen days.

The experiments shows us that the woodchips has a moisture content above the 40% which is normal for fresh wood. The woodchips ranging from 0-20 and 0-100 mm have a moisture content round the 49%, this could be caused by the circumstances that the wood is fresh or less dried. The moisture content of woodchips with particle sizes of 0 – 40 mm have an average value round 42%. The moisture content would not increase or decrease with the different sizes of the particles. Woodchips are less efficient to storage with respect to the volume energy ratio. Another problem is the risk of composting, causing material loss and degradation, and potential fire by self-heating. The water may also condense and this may lead to corrosion of the equipment.

Wood pellets with the diameter of 6 and 8 mm contain round the 8% moisture. They fulfill the fabricated standard CEN/TS 14961:2005. A wood pellet of 12 mm has a higher moisture content and does not fulfill the quality of the standards. BO_2 contains the lowest moisture with a value of 4% and is the most efficient for transport and storage, because the heating value is bigger when it contains less moisture. The less moisture the bigger the net energy density by mass.

The angles of repose for the three methods were significantly different, it is advisable to report and describe the angle of repose calculations. The pile of the wood pellets formed an almost perfect shape cone. For all wood pellets the angle of repose was 30% with the calculation for the perfect cone. The pile of the BO_2 pellets shows in the experiments a similarity with a perfect cone with an average angle of repose of 31%. The wood chips with different sizes have also more less the same outcome for the angle of repose and lies round the 45%. The pile of the woodchips has a similarity with a cone that has been flatted. The calculations for the angle of repose are thus based by this method. Also the first method gives a good estimation. The conclusion is that the outcome is based on the type of the material and not the size of the particles or the moisture content.

The time consolidation experiments show an irregular behavior. In case of the wood pellets the inclination becomes stable after four to five days. The pellets with a diameter of 12 mm are quick stable. This could be declarable because the bigger pellets are better settled in the beginning before the weight is put.

Woodchips are more cohesive particles which results in caking due its higher moisture content while the wood pellets exhibits no caking due its low moisture content and smooth surface. The caking in the woodchips experiments can cause flow ability problems in the silos. It is hard to conclude because of the less amount of the experiments still we see that with the large woodchips the consolidation is settled quicker. The explanation of this effect could be that large wooden chips could carry the applied stresses better, because there is less void. The effect is that the other smaller particles do not consolidate.