FIBER CONTENT AS AN INDICATOR OF PEAT DECOMPOSITION

Joonas Sandman
Johann Heinrich Von Thünen-institute, Bundesallee 50, 38116 Braunschweig, Germany
Supervisor Dr. Ullrich Dettmann
Ostfalia Hochschule für angewandte Wissenschaften, Am Exer, 38302 Wolfenbüttel, Germany
Supervisor Prof. Dr. Elke Wilharm

Declaration of originality

I, Joonas Sandman, matriculation number 70460940, declare that the following contents are entirely my own work unless explicitly acknowledged, including citations of published and unpublished sources. The work has not previously been submitted in any form to Ostfalia Hochschule für angewandte Wissenschaften or any other institution for assessment for any other purpose.

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Abstract

Biogeochemical processes in peatlands are primarily controlled by the soil properties peat. While dependant on botanical origins and degree of decomposition, these properties are highly variable. The degree of decomposition can be used as an indicator for the ecological, hydrological and carbon storage functions of peat and peatlands. A commonly used field test for classification of peat decompositions is the Von-Post method, which is a test performed by squeezing an egg-sized sample of peat and observing the quality of the evacuated liquid and the remaining solids and any possible residue or paste. However, as such the test is subjective, and the result depends on the personal judgement of the sampler.

This study was carried out to prove that peat fiber content is an objective indicator of degree of decomposition of different peats using nearly a hundred different peat samples taken from different locations around Europe. Each sample was diluted into a $(NaPO_3)_6$-solution, sieved and dried, and the dry weights were compared with an undiluted, unsieved dried control. The dry mass in the sieve divided by the dry mass in the control represented the fiber content mass percentage (FC) of each sample. The measurements were carried out in triplicates.

The collected data was compared against pre-existing set of soil profiles and other information gathered by previous projects of Thünen institute. The study found that across the set of different peat samples the ones with higher degree of decomposition in general had a lower FC. The samples also had a lower total organic carbon (TOC), Carbon-Nitrogen ratio (C/N), as well as porosity and saturated water content (θ_s) and hydraulic conductivity (K_s), as suggested by previous studies. However, the FC results had a high level of variance within the triplicates due to the heterogeneous nature of natural peat, leading to large error margins. Therefore, more repetitions, perhaps with larger sample masses are required for more accurate results.

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Introduction and theory

Peat and peatlands

Fens and Bogs

To understand peat, it is important to understand peatlands. They are areas with a water table near, or at the surface, where the rate of biomass production exceeds the rate of decomposition (Maanvilja;Aapala;Haapalehto;Kotiaho;& Tuittila, 2014). While also present in the tropical climate, these areas are most common in the northern temporal climate, where the cool and humid environment favors peat accumulation (Kuhry & Vitt, 1996). Peatlands are divided into two main groups, ombrotrophic (bogs) and minerotrophic (fens), due to their characteristic environmental conditions required for peat accumulation and growth (Verhoeven, Koerselman, & Beltman, 1988; Dettmann, 2016).

According to the Canadian Sphagnum Peat Moss Association, bogs often have a raised center and are isolated form mineralized waters, having main source of nutrients being precipitation and wind. Due to the general low nutrient content bogs have flora that has adapted to both high water table and low nutrient concentrations. The pH of bogs is generally under 4,5, which is quite acidic, thus inhibiting bacterial decomposition of organic matter (Verhoeven, Koerselman, & Beltman, 1988; Canadian Sphagnum Peat Moss Association (CSPMA), 2018).

Similar to bogs, fens also have high water tables required by peat growth, but what sets them aside from bogs is the nutrient sourcing from nearby mineral terrain or fertilized agricultural lands. With the enhanced nutrient and mineral contents, fens generally have herbaceous plants growing on them (Verhoeven, Koerselman, & Beltman, 1988).

Formation of peat

Peat is mostly made up of plant matter in varying stages of decomposition found in waterlogged areas, such as fens and bogs mentioned above. The high water table in these waterlogged areas make it possible for the decomposition process is halted or significantly slowed down by the low pH-value and anoxic conditions, which make swamps, fens and bogs excellent for preserving organic matter such as plant stalks and leaves. This antiseptic property of swamplands is what allows the plant fibers to be conserved potentially for thousands of years inside the peat, which is the basis of peat soil formation (Belyea & Clymo, 2001).

As the aquatic plants grow and die, their fibers are stored in the peat in a suspended or near-suspended state of decomposition. As time passes, the plant matter stacks on top of itself, creating peat soil. The deeper the soil, the denser it is, as vertical pressure is applied by the masses of water and peat soil above. This causes certain changes in the peat soil properties, such as higher bulk density and decreased porosity. This initial high porosity of peat is what allows the water levels to fluxuate in the active top layer, or acrotelm, while the denser, inactive layer beneath, the catotelm, inhibits excess drainage (Belyea & Clymo, 2001).

Functions and utilization of peat

Peat has several ecological functions. The plant matter that comprises peat, due to not degrading, effectively suspends carbon in the carbon cycle and out form the atmospheric carbon (Fraser;Roulet;& Moore, 2001). In addition, peatlands are an extremely effective natural water purifier as well as a habitat for numerous species of flora and fauna (McMorrow;Cutler;Evans;& Al-Roichdi, 2010; Ohlson;Söderström;Hörnberg;Zackrisson;& Hermansson, 1997), sometimes unique to peatlands. In fact, peatland restoration has been successfully used to replenish dwindling populations of certain wildlife in multiple locations (Meli;Benayas;Balvanera;& Ramos, 2014).

That is not the only potential function of peat. Due to the relatively high fiber content of peat it is combustible and has enough calorific value to be used as fuel (Johansson;Persson;& Albano, 1987). It is considered a semi-renewable energy-source, which is somewhat misleading. The formation of peat takes thousands of years (Kuhry & Vitt, 1996) and harvesting of peat may cause irreparable damage to the local environment in the harvesting site. In fact, although peatlands cover under 3% of land on Earth, they are responsible for approximately 8% of the global CH_4 flux (Keller & Bridgham, 2007),or about 1-10 gCH_4/m^2 (Moore & Knowles, 1990), as well as 10% of Earth's freshwater resources and 15-30% of soil carbon (Dettmann, 2016).

The harvesting of peat and the use of peatlands for forestry or agriculture require the drainage of the location (Boffey, 1975; Maanvilja;Aapala;Haapalehto;Kotiaho;& Tuittila, 2014; Ohlson;Söderström;Hörnberg;Zackrisson;& Hermansson, 1997; Verhoeven & Setter, 2009). This causes the suspension of the degradation to be lifted as the anoxic conditions are no longer present, which in turn results in increased CO_2-emissions and corrosion of the capacity for carbon sequestration of peat (Dettmann, 2016; Waddington;Warner;& Kennedy, 2002; Verhoeven & Setter, 2009; Kasimir-Klemedtsson, ym., 1997), as well as damages the biodiversity of the area (Maanvilja;Aapala;Haapalehto;Kotiaho;& Tuittila, 2014).

Furthermore, the removal of the flora on the top layer and the draught caused by the drainage renders the resulting peatlands to be uncolonizable by the aquatic flora typical of peatlands. Without the plants required for fiber mass growth the peatland will not be able to regrow (Dettmann, 2016).

Peat soil properties

A central factor in peat soil properties is the degree of decomposition, which dictates much of how the peat is and behaves, as well as how much sequestrated carbon it holds, and potentially emits. There are three main decomposition categories of peat (Boelter, 1968):

- Fibric
  - Least decomposed
  - Intact fibers
- Hemic
  - Partially decomposed
- Sapric
  - Most decomposed

The study of peat soil properties poses a challenge for researchers, as they are prone to change under different conditions. For an example, when sampling peat underfoot, the bodyweight of the researcher may cause vertical compression on the peat, potentially affecting the results (Dettmann, 2016; Grover & Baldock, 2012).

Another more common factor that affects peat soil properties is the water level. A saturated peat generally has a higher hydraulic conductivity as the pores are kept open by the water. When the water level drops, for an example due to artificial drainage for development purposes, the pores may experience a type of gradual collapse, as well as accelerated decomposition and decrease in pore interconnectedness, thus lowering the hydraulic conductivity and by that potentially altering the water table (Belyea & Clymo, 2001).

Fiber content

Fibers are organic particles that exceed an arbitrarily chosen size requirement, usually the arbitrarily chosen mesh-size of the sieve used in the measurement (Boelter, 1968). The fiber content and size of the particles have several effects on the function and behavior of the soil. Namely, longer, or bigger, fibers allow for larger degree of porosity as well as bigger and more interconnected pores, positively influencing the hydraulic conductivity and water retention abilities of the peat. The older peat soil typically found in the lower layers tends to be further decomposed and with a lower fiber content, smaller fibers and a higher bulk density (Belyea & Clymo, 2001).

Bulk density, saturated water content and porosity

Bulk density (BD) is the mass of dry material per volume and can be used as an indicator for the degree of decomposition (Boelter, 1968). As mentioned above, the bulk density increases with the depth and age due to decomposition and compression, leading to the applicability as a measure of decomposition. By extension, the same applies to saturated water content (θ_S), or porosity (ϕ), as the two are inversely proportional with a close correlation by nature. θ_s and ϕ are used interchangeably in this paper as they are equal in value once cm^3/cm^3 is translated into a percentage.

Hydraulic conductivity

Saturated hydraulic conductivity (K_s) simply describes the rate that water passes through the soil. This quality is interesting because it has an effect on the water characteristics of peat and other organic soils. This soil property is highly variable (Boelter, 1968; Holden & Burt, 2003), as will be evident later in the results and discussions section.

Total organic carbon and Carbon-Nitrogen ratio

Total organic carbon (TOC) is the amount of organic carbons in organic matter. It does not take into account the inorganic carbon (Nelson & Sommers, 1982). The carbon-nitrogen (C/N) ratio is the ratio of Total Carbon to Nitrogen, which is used to calculate the rate and total amount of decay. The C/N generally lowers as peat matures, due to the carbon being decayed and nitrogen levels being enriched through the decomposition process (Kuhry & Vitt, 1996). As an indicator for nitrogen availability, C/N is important in agricultural peatland usage, as indicated by the change in the ratio in agricultural use (Murty;Kirschbaum;McMutrie;& McGilvray, 2002).

The von Post method of peat decomposition determination

The von Post field test was created by von Post in 1922, and is a popular and reliable, albeit admittedly subjective, field test in a very simplified form. A handful of peat is taken on the palm of the hand and squeezed with the fingers apart enough for water to escape, but close enough to hold the solids in the palm. Enough pressure is applied to evacuate most of the water in the sample, after which the volume percentage and the optical quality of the passed water and matter are evaluated and an “H-value” (referred to as “VP-value” in this paper for clarity) is assigned based on those qualities (Verry, et al., 2011; Malterer, Verry, & Erjavec, 1992; Grover & Baldock, 2012; Blackland centre, 2018).

The von Post categories of decomposition are as follows (Blackland centre, 2018):

Von Post	Description/criteria
1	Completely undecomposed peat, releases clear water. Easily identifiable plant remains, no amorphous materials
2	Almost entirely undecomposed peat, releases clear or yellowish water. Easily identifiable plant remains, no amorphous materials.
3	Very slightly decomposed peat, releases muddy brown water but no solids. Identifiable plant remains, no amorphous materials.

4	Slightly decomposed peat, releases very muddy brown water but no solids. Plant remains slightly pasty and have lost some identifiable features.
5	Moderately decomposed peat, releases very muddy water with small amounts of granular peat. Plant remains structure indistinct, with some recognizable features. Very pasty residue.
6	Moderately highly decomposed peat, with indistinct plant structure. About 1/3 peat released when squeezed. Residue very pasty, but some plant structure identifiable.
7	Highly decomposed peat. A lot of amorphous material with very poorly recognizable plant structure. ½ of peat released when squeezed, released water is very dark and almost pasty.
8	Very highly decomposed peat with a large quantity of amorphous material and very indistinct plant structure. 2/3 of peat released when squeezed, may release small amounts of pasty water. Plant remains decomposition resistant roots and/or fibers.
9	Practically fully decomposed peat, hardly any identifiable plant structure. Fairly uniform paste.
10	Completely decomposed peat, no plant structure, everything passes through fingers upon squeezing.

Scope and aims of the study

This study aims to prove that the fiber content is a viable and objective indicator for the degree of decomposition. The study was conducted using a modified version of the USDA fiber volume test (Malterer;Verry;& Erjavec, 1992), where instead of volume the measuring was performed on the dry mass of the peat. A secondary experiment was carried out to determine the water content at the permanent wilting point (θ_{PWP}) of the samples at -15 bars (Weiss;Alm;Laiho;& Laine, 1998) with a 15-bar suction. The study used a variety of samples provided by the Thünen institute, which have been used in previous projects. The results of the study can be used for further investigation of peatlands and peat soils, for an example a better regionalization of water levels (Bechtold, ym., 2014) or soil moisture in peatlands, the development of pedotransfer functions or the estimation of greenhouse gas emissions.

Methods and materials

Fiber content measurement

The fiber content was measured by sieving peat samples with a 1mm sieve with a 10 cm diameter and comparing the mass of the dried sieved sample with the dry unsieved control. The mass was weighed before and after drying in each case. The fibers would be held by the sieve, while any small minerals or other small debris were flushed through. The difference of the dry masses is indicative of the mass percentage of fibers still in the retained sample in the sieve.

The fiber mass percentage is found by the following equation:

$$Fibre\ mass\ percentage\ [\%] = \frac{Dry\ sieved\ \ solids\ [g]}{Dry\ control\ solids\ [g]} \cdot 100 \qquad (1)$$

Furthermore, another notable factor is the possibility of a higher than usual mineral content in the peat samples, as some samples used have some percentage of sand and, in some cases, even construction waste which has been mixed in with the soil at the location.

The samples were taken in triplicates from each analysed peat species, so that there were three sieved samples and three unsieved controls from each sample type. This study used 25-gram samples. The sieved samples were initially measured into a plastic bottle, which would then have $(NaPO_3)_6$-solution added, which will be further explained below. The bottles were then set in the rotary mixer for overnight, or about 24 hours. The unsieved controls were measured directly into aluminium vessels and dried at 80°C for at least 12 hours, or until the weight has stabilized.

The dilution time of the samples was relatively uniform, with each sample being diluted for at least 48 hours. However, over the weekend the dilution time can be stretched to as long as 72 hours. As is later discussed in this study, this was proven to have no major effect on the process and allowed the continuity of the measurements over the weekend.

The daily number of samples processed was limited to 12 by the available equipment, namely the rotary mixer used for over-night mixing of the dissolved samples, which has slots for 12 bottles. The rest of the equipment, such as sieves and bottles, were commissioned according to this limitation.

Therefore, keeping the mixer’s limitations and the required dilution time in mind, 24 samples would be bottled at any moment; 12 to be mixed overnight and sieved the next day and another 12 to be mixed the night after.

In the dissolving process heavy emphasis was not placed on the exact amount of solution per each bottle of sample, rather the bottles were filled over half-full to discourage formation of sediments on the sides during the mixing process.

After the mixing process the contents of the bottles were poured on the 1 mm sieves and flushed with tap water by additional five times to ensure as much of the <1 mm diameter particles as possible are flushed away.

After flushing and draining the samples were placed in the drying oven at 80°C for approximately 12 hours. After drying they are weighed, the result of which will be the dry weigh + the sieve. The masses of the empty sieves were used to determine the mass of the dry matter using the following formula:

$$Dry\ sieved\ solids\ [g] = Dry\ Mass\ with\ Sieve\ [g] - Mass\ of\ Empty\ Sieve[g] \qquad (2)$$

15 bar wilting point measurement

This measurement was done by inserting samples in small cylindrical rings set inside a pressure membrane apparatus (Sreedeep & Singh, 2006), which would be pressurized to approximately 15 bars of air pressure. The rings would hold the peat under small cylindrical weighs to ensure that the soil matrix has contact to the semipermeable membrane. The pressure would push the water out through a hole in the centre of the press, through semi-permeable membranes which allow only water to penetrate, leaving the air pressure inside along with the sample solids. The excess water would flow into a container outside the press. The container would be weighed daily until the mass of the water inside the container stabilizes, which indicates the hydraulic equilibrium. The resulting masses of peat were gravimetrically measured.

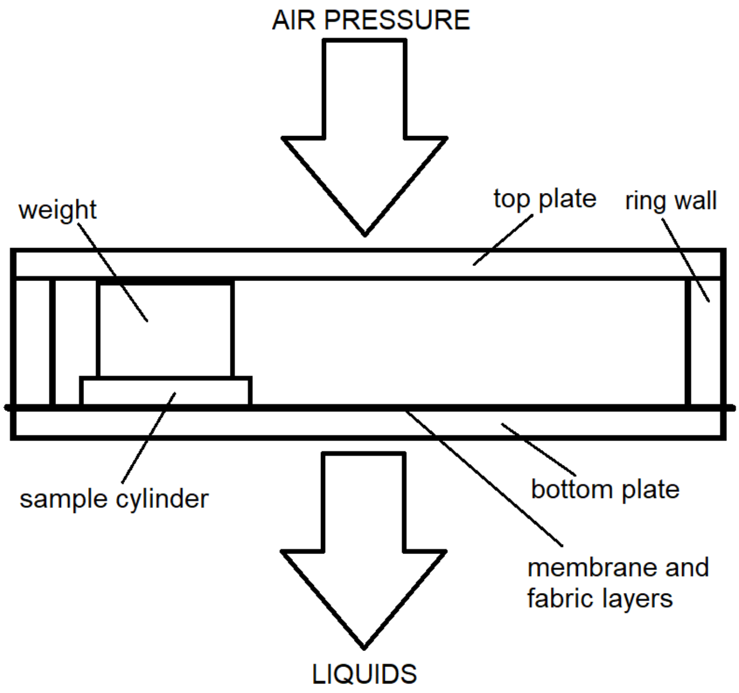

Figure 1 A conceptual cross section of the wilting point press.

The apparatus itself was cylindrical, with two discs and a large cylindrical milled steel ring wall around the circumference. On the bottom plate first three layers of humidity-transferring fabrics were placed, then another three layers of semi-permeable membranes. This arrangement would allow the water to evacuate the samples and proceed to the draining hole in the middle of the bottom plate. The top plate would be pressed hard against the cylindrical circumference wall and the samples themselves, creating an air-tight pressure pocket inside the press with the aid of rubber gasket rings on either side of the ring wall, and ensured contact between the samples and the membrane layer.

The discharged water was collected into a plastic vessel and measured daily. When the mass of the measured water stabilized it was safe to assume that the samples have reached a hydraulic equilibrium. After the samples reached hydraulic equilibrium, the samples were weighed and dried for 48 hours at 80°C. The gravimetrical water content was calculated with the following equation:

$$\theta_{grav} = \frac{sample\ wet\ mass\ [g] - sample\ dry\ mass\ [g]}{sample\ dry\ mass\ [g]} \quad (3)$$

Figure 2 Placing the weighs on top of the sample cylinders in the press.

The samples

The samples were taken from several locations in Europe across different countries. In this study the samples used were mostly taken from Germany, Estonia and several Northern European countries, namely Denmark, Finland and Sweden. The sample naming follows a specific logic: first is a two- or three-letter code denominating the sampling country or location, second is the place of sampling within the specific country and last is the Horizon number, or the depth of sampling. An example of a typical sample name would be FI_P6_H2, meaning that the sample was taken in Finland at “place 6” from the depth of approximately between 10 and 20cm. The samples used are listed in the table in appendix 1. Note that the first letters may also denote a regional location, in which case the samples were taken from within Germany.

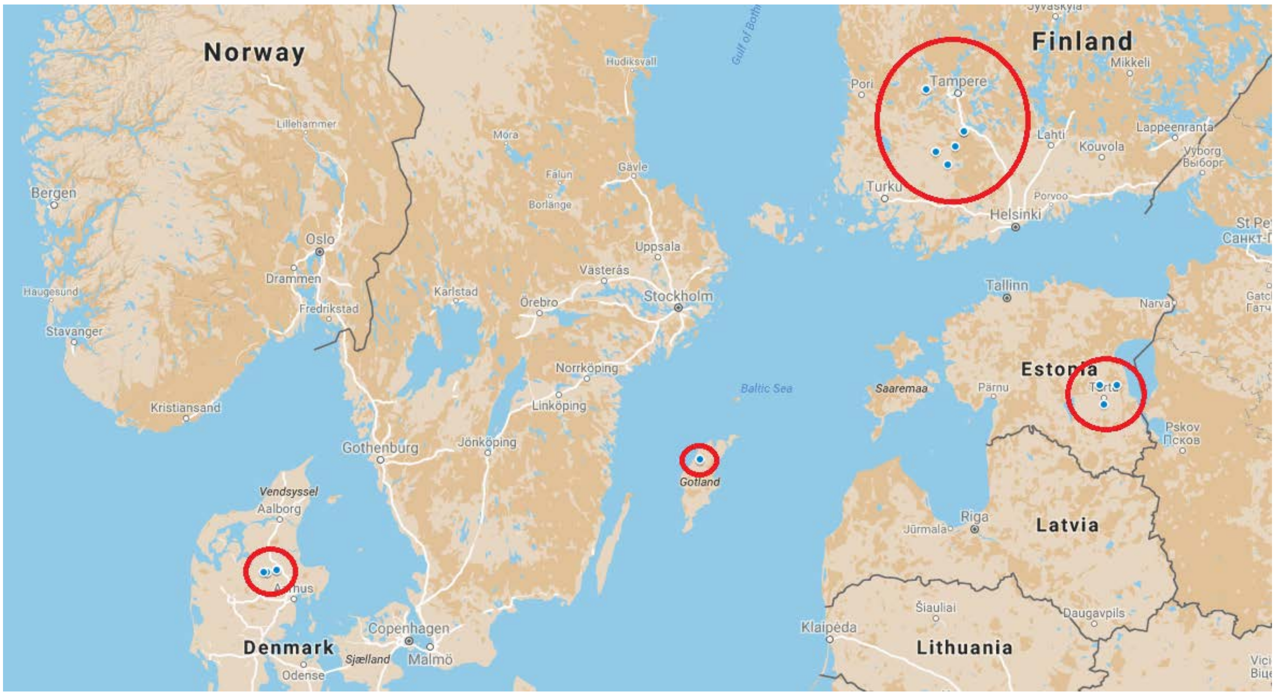

Figure 3 Map of sample locations in northern Europe.

Preparing the sodium hexametaphosphate-solution ($(NaPO_3)_6$)

The hexametaphosphate-solution had a catalytic role of assisting in the dissolving of soil aggregates and other unwanted solids from the samples.

The $(NaPO_3)_6$ was mixed in with distilled water using a magnetic mixer in smaller batches of 50 grams of salt in 500 ml of water so that the solids were slowly added into the water to help them dissolve more rapidly by preventing the formation of large solid formations that take significantly longer to dissolve.

When the small batch of solution was clear, and no solids were easily detectable the beaker was emptied into a 5 000 ml volumetric flask. This process would be repeated until there is 2 500 ml of 10% concentration $(NaPO_3)_6$-solution in the flask, after which the rest of the flask was filled with distilled water, bringing the solution to 5 000 ml of 5% $(NaPO_3)_6$.

Analysis

The collected data was inserted in Microsoft Excel. The data would then be analysed and compared to each other, as well as against pre-existing set of soil profiles, which hold information on decomposition (von Post-value), sampling depths, locations, bulk densities etc. The comparison between the new information on fiber content and the pre-existing information provides potential new insights into the nature of the decomposition process of peat.

The pre-existing information from the soil profiles include such things as:

- Location of sampling
- Peatland and peat type
- Von Post-value
- Depth of sampling/Horizon
- Total organic content [%]
- Carbon-to-Nitrogen -ratio [%]
- Bulk density [g/cm^3]
- Porosity [%]
- Saturated hydraulic conductivity [cm/s]

These factors were taken into consideration during the analysis process in combination with the gathered data. The error estimation was done using the standard error of the mean to a 95% confidence interval.

Results and discussions

Methodical experiments

The research method used in this thesis was proven by a set of three different methodical experiments. The experiments were designed to prove that the sample mass does not affect the fiber content measurement in any significant magnitude, as well as to find the optimum, or minimum, dilution time to ensure that the samples were brought to an equilibrium in the dilution process.

Experiments 1 and 3 were carried out using the homogenized agricultural peat mixture, while experiment 2 was carried out using different natural peats, which are named below in the corresponding section. The large sample masses of 50 and 100 grams had to be sieved through a wider, 20.5 cm sieve, while the 25-gram samples were sieved through the 10 cm wide sieves. Each experiment was carried out in triplicates.

Experiment 1 – influence of sample mass, horticultural peat

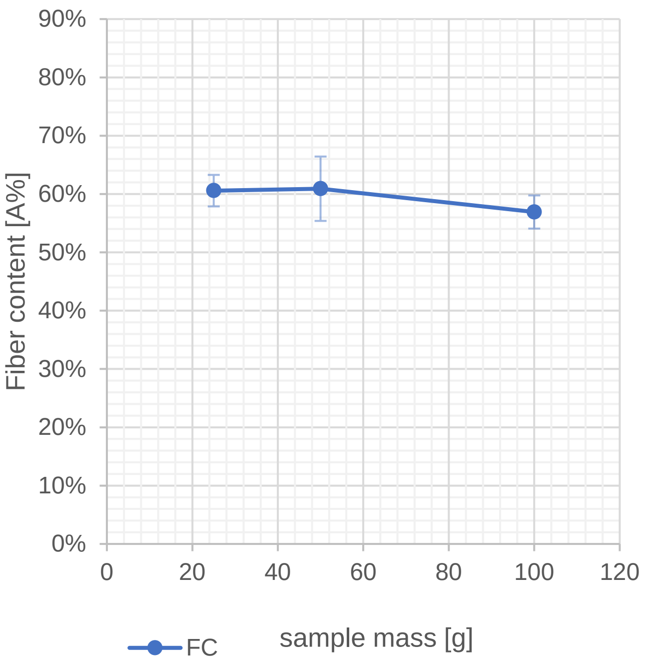

Figure 4 Fiber content [%] over sample mass [g] of horticultural peat with 24-hour dilution time.

The variable mass experiment was carried out using three different masses, namely 25, 50 and 100 grams, of the homogenized peat mixture. Each mass amount was diluted in the $(NaPO_3)_6$-solution, while undiluted, unsieved controls were dried untreated.

The difference in fiber content would reveal if the mass would affect the result in any significant way.

It was found that the homogeneous peat mixture does not experience any large variation in the fiber content measurement between the varying sample masses. As shown in Figure 4 and Table 2, The variations between the results are minimal, the result for 100 gram-sample has slightly lower fiber content result probably due to the use of different equipment, namely the use of a wider diameter sieve, which allowed the flushing to be done more efficiently.

The homogeneous peat was especially difficult to sieve through the smaller diameter sieves due to the relatively low water content in the sample during weighing, which lead to relatively large volumes of soil in the small sieves, thus clogging the passage of water in the flushing process. This would generally be less of a problem as the flushing process went on, as most of the clogging agents would be eventually flushed out.

The variance due to the equipment was not a factor in the making of the experiment itself, as the larger diameter sieves were not required for the 25-gram samples.

Table 1 The results of experiment 1 with 24-hour dilution time.

Sample mass [g]	25	50	100
Fiber content [%]	60.63 (± 2.70)	60.91 (± 5.52)	56.91 (± 2.84)

Experiment 2 – influence of sample mass, natural peat

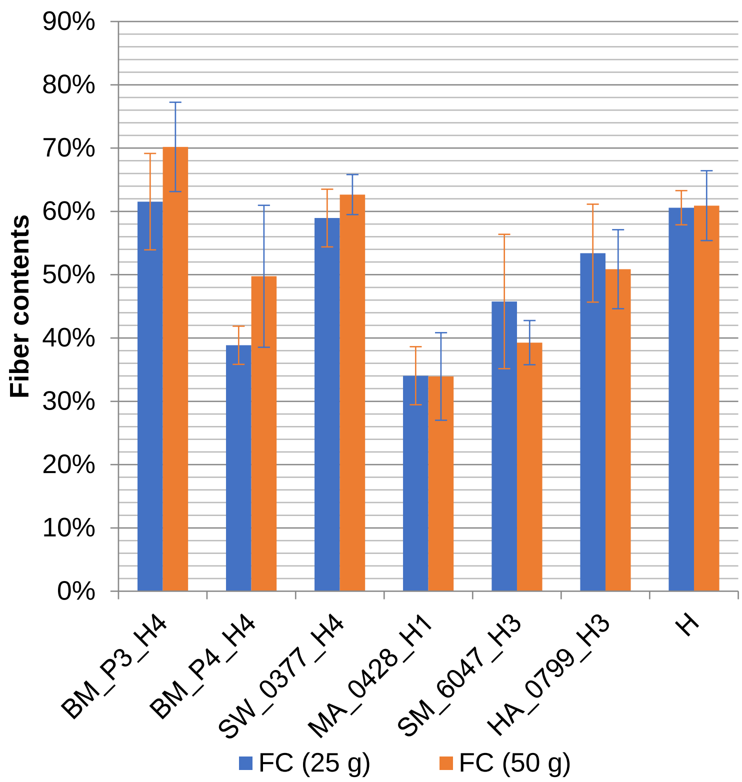

Figure 5 Fiber content [%] of 25 and 50-gram samples of natural peat and the horticultural mixture. Natural samples were with 48-hour dilution time, horticultural mixture with 24-hour.

The principle of the second experiment was similar to the first one in that the effect of mass on the fiber content measurement was examined. However, this experiment was carried out using heterogeneous, natural peat and with only 25 and 50-gram samples. 100-gram samples were no longer used in order to minimize loss of peat. There were six different samples and each weight was sampled in triplicates.

The difference in fiber content would reveal if the mass would affect the result in any significant way.

Similar to experiment 1, it was found that the natural peat does not experience any substantial variation in the fiber content measurement between the varying sample masses. As shown in the Figure 4 and Table 3 below, the fiber contents were relatively uniform between the varying sample masses. However, there is some more variance in the results of the natural peats than the horticultural peat mixture, most probably due to the heterogeneous nature of the peat, which also contributed to the wide error margins present in Figure 5 and Table 3.

Table 2 The results of experiment 2, results for both 25- and 50-gram experiments as well as the difference between the results. All natural samples were diluted for 48 hours, the horticultural mix for 24 hours.

sample	FC (25 g) [%]	FC (50 g) [%]	∆FC [%]
BM_P3_H4	61.54 (± 7.61)	70.19 (± 7.06)	8.65 (± 14.67)
BM_P4_H4	38.85 (± 3.02)	49.75 (± 11.21)	10.90 (± 14.23)
SW_0377_H4	58.95 (± 4.56)	62.66 (± 3.16)	3.71 (± 7.72)
MA_0428_H1	34.04 (± 4.58)	33.92 (± 6.92)	-0.12 (± 11.50)
SM_6047_H3	45.77 (± 10.61)	39.27 (± 3.49)	-6.50 (± 14.10)
HA_0799_H3	53.41 (± 7.74)	50.87 (± 6.24)	-2.54 (± 13.98)
H	60.63 (± 2.70)	60.91 (± 5.52)	0.28 (± 8.22)

Experiment 3 – influence of dilution time, horticultural peat

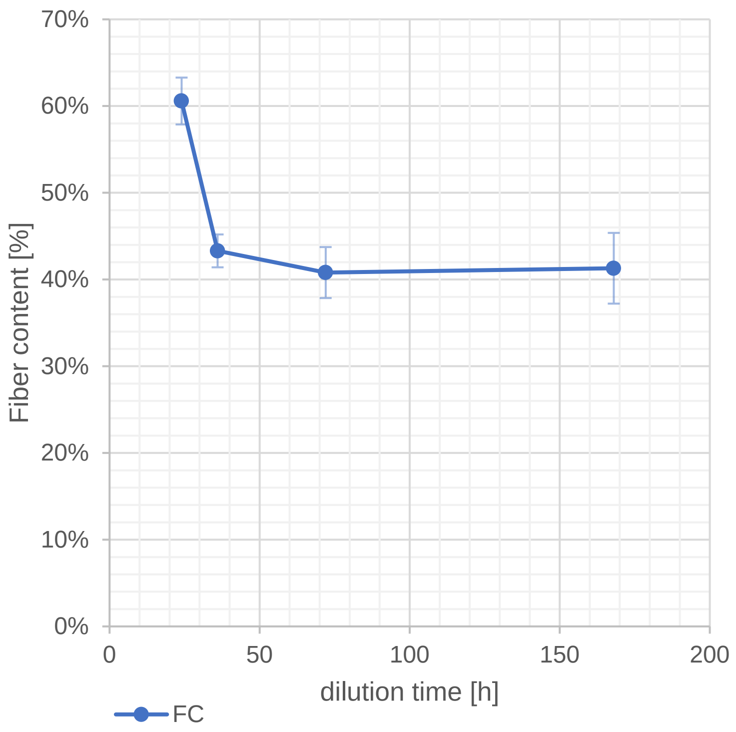

Figure 6 Fiber content [%] as a function of dilution time [h] using a 25-gram sample size.

This experiment was carried out using the horticultural peat mixture with 25-gram samplings. All the samples were saturated with the $(NaPO_3)_6$-solution on the same day but sieved in intervals so that dilution times of 24, 36, 72 and 168 hours would be achieved.

The difference in fiber content would reveal if the dilution time would affect the result in any significant way.

The experiment found that the homogenized peat mixture experiences significant change in fiber content until approximately 36 hours dilution time, after which the fiber content stabilizes, as shown in Figure 6 and Table 4 below. Due to this stabilization, and the fiber content not varying to any substantial magnitude, the dilution time to be used in the project was decided to be, at minimum, 48 hours. During the dilution any aggregates or small particles are ideally dissolved in the sodium hexametaphosphate, leaving only the fibers. If the dilution time is too low, there are still unwanted solids in the soil, causing an inflation in the fiber content measurement result, such as in the results of 24-hour dilution. (Levesque & Dinel, 1977)

Table 3 The results of experiment 3.

Dilution time [h]	24	36	72	168
FC (25 g) [%]	60.63 (± 2.70)	43.44 (± 1.90)	40.84 (± 2.94)	41.33 (± 4.08)

As the results show, the fiber content rises slightly after one week of dilution. However, at 0,5% this rise is in within the error-margin, and as such can be considered negligible.

General peat soil properties

In this section the soil- and physical properties of the used samples are described and compared for a more thorough understanding of the type of soil and to understand the possible correlations between the other properties and FC. All other properties than fiber content and some of the data from the permanent wilting point experiment are from pre-existing data provided by the Thünen institute.

Degree of decomposition and depth of sampling

As previously found by Boelter (1968) and others, the decomposition of peat varies by depth of sampling, among other variables, such as peat age and water level. The surface peats in general are more decomposed due to the aerobic conditions (Kuhry & Vitt, 1996; Boelter, 1968). This is true in the samples of this study as well.

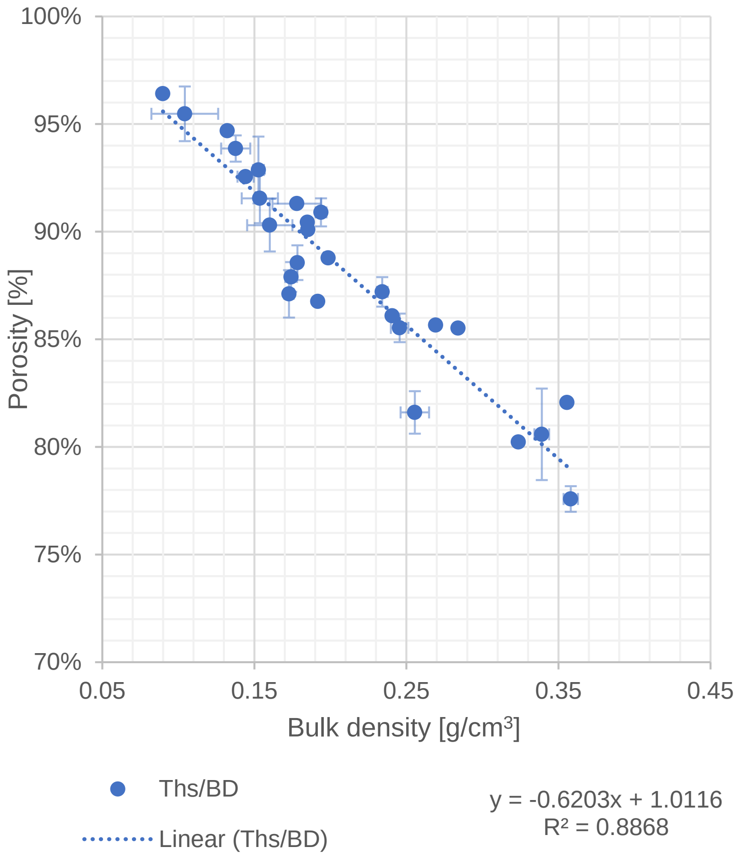

Figure 7 *Porosity* [%] over Bulk density [g/cm^3].

Bulk density and porosity

Due to the close correlation and relationship between these parameters they are examined together. Porosity is inversely proportional to bulk density, as it describes the saturated water content and porosity of the peat. The more porous the peat is, the less dense it is by extension, as can be seen in Figure 7. The divergence of the points from the trend line is minimal, with most of the values landing very close to the trend line, which also supports the notion that the values are closely related (Boelter, 1968).

As can be seen in Figure 8 below, the bulk density value itself is correlated to the level of decomposition. As the level of decomposition increases the BD value rises, meaning that the sapric peat generally has higher bulk density, while the fibric peat has lower. This is somewhat expected, because the more decomposed peat has less structure and long fibers, leading to denser characteristics (Boelter, 1968; Verry, ym., 2011). Naturally the opposite is true for porosity. As the level of humification increases the porosity gradually lowers. This effect is due to the fibers breaking down, lessening the required structure for porosity.

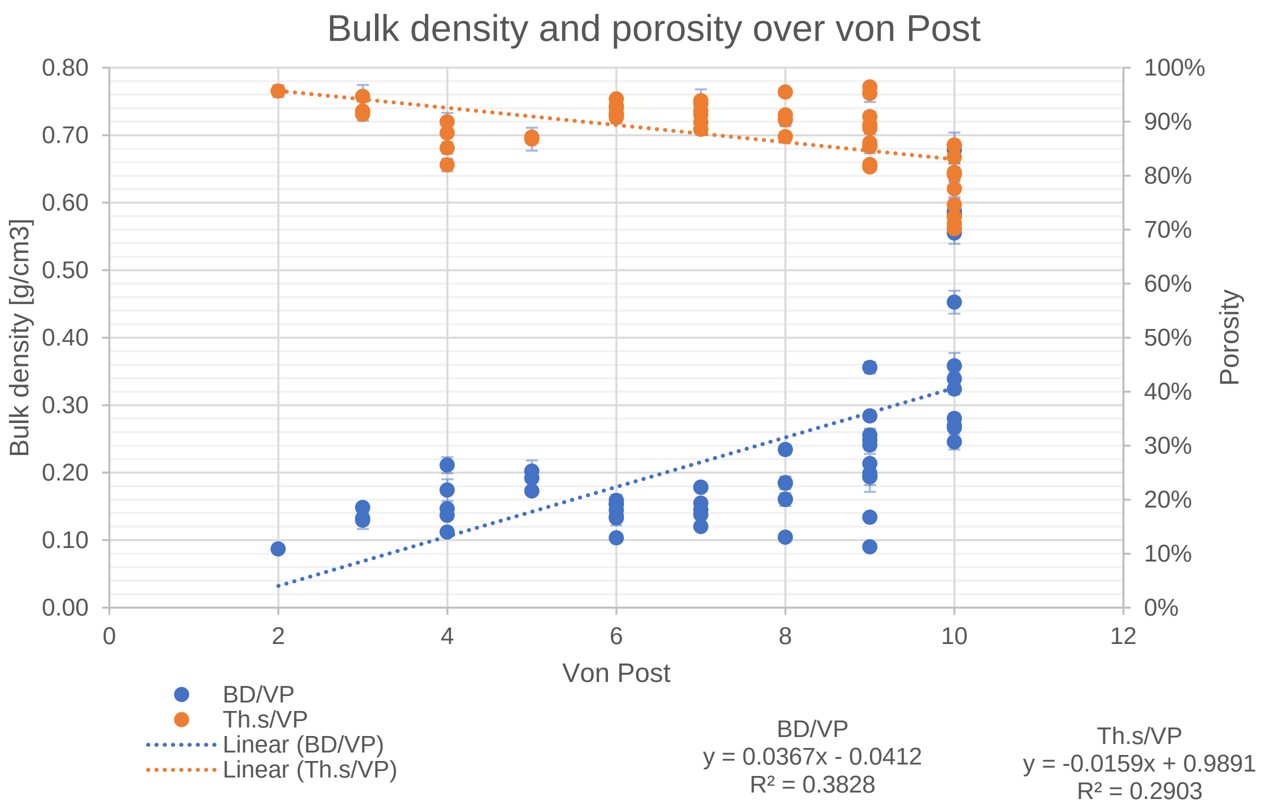

Figure 8 Bulk density [g/cm3] and porosity [%] over von Post -value.

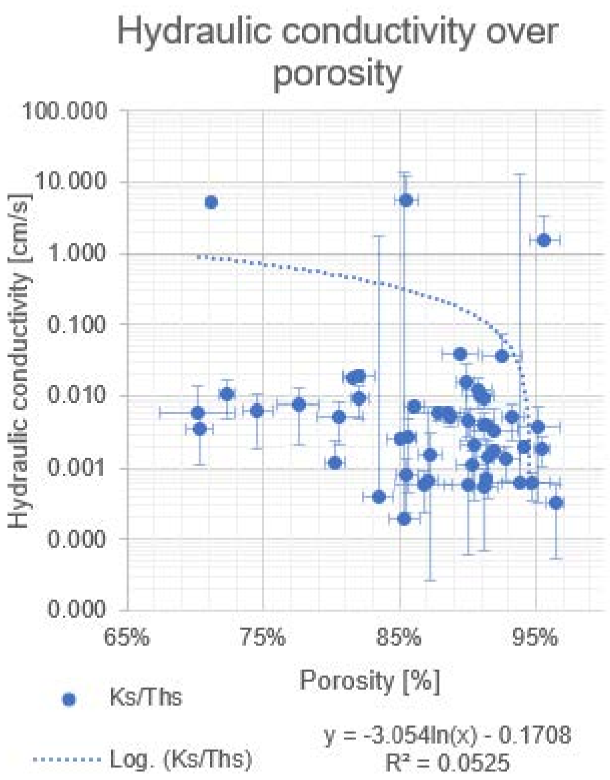

Figure 9 Saturated hydraulic conductivity [cm/s] over Porosity [%].

This results in less, and smaller pores (Boelter, 1968). It should be emphasized that stage of decomposition is determined by the soil mapper in the field and, therefore, as a subjective measurement size, may vary among different soil mappers.

As Figure 8 shows, the porosity of the samples varied from about 70% to over 95%, while bulk density varies from approximately 0.10 g/cm^3 to nearly 0.70 g/cm^3. Due to the S-curve shape of the results, the values for bulk density and porosity come closer at von Post 4, than the surrounding degrees of decomposition. This could be due to the variable nature and heterogeneity of peat soil, and with more repetitions the values would probably show a more linear progression.

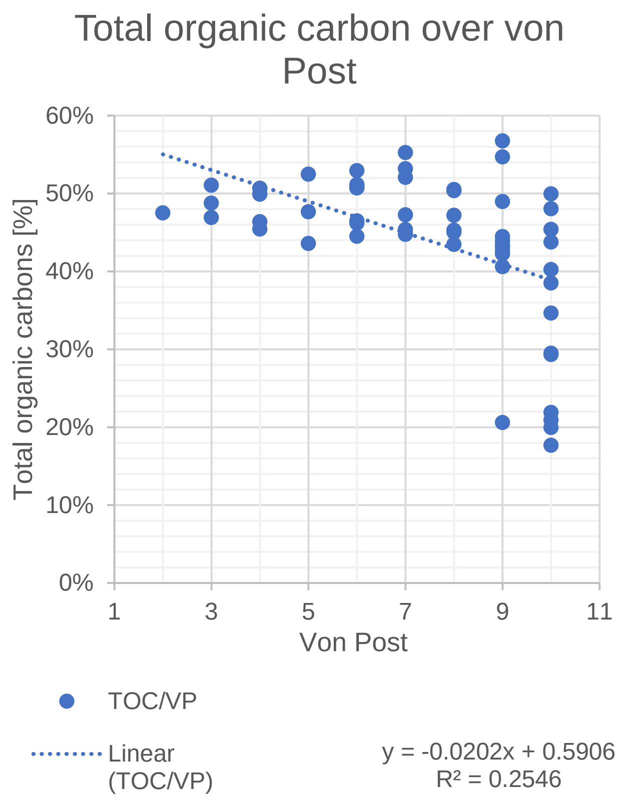

Figure 10 Total organic carbon [%] over the Von Post -value.

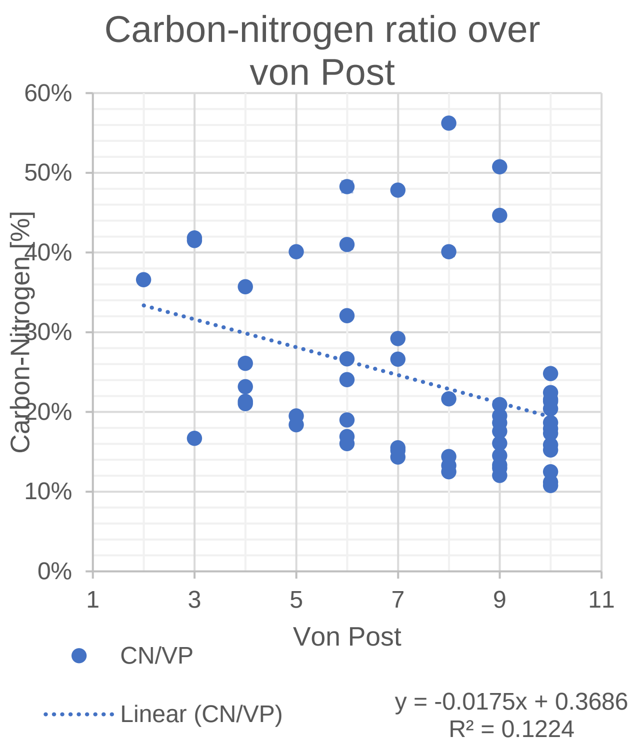

Figure 11 Carbon-nitrogen ratio [%] over the von Post -value.

Hydraulic conductivity

As can be seen in Figure 9, the average K_s of the examined samples seem to have uniform average across all values of θ_s. However, there are a few samples that exhibit highly enhanced values of K_s, namely FI_P6_H4, DK_P4_H2 and FI_P2_H1 with values of approximately 1.5 cm/s, 5.7 cm/s and 5.3 cm/s, respectively. These values are over a hundred-fold compared to the next largest one, which confirms that Ks is a highly variable factor, as is common knowledge (Holden & Burt, 2003).

Carbon-nitrogen ratio, total organic carbon and total organic carbon density

When the total organic carbon is plotted over von Post values in Figure 10, it is clearly seen that the sapric peats are have far less organic carbons. In the most decomposed von Post-category there are several samples at the 20% TOC range, while the rest are generally at least double.

C/N ratio is the mass ratio of carbon to nitrogen in the soil. When compared to the degree of decomposition in Figure 11, it is apparent that while the majority of highly decomposed samples have lower CN-ratios, the highest values are found also in the highly decomposed peats, as the values overgo a scattering as the level of decomposition increases. This may be caused by the wide range of sample locations, where some locations are nitrogen-rich fens, while the others are nitrogen-deprived bogs (Kuhry & Vitt, 1996).

Curiously, when the VP-value reaches 10, there are no more high C/N-values found in the samples used in this study. Reasons for this could be enhanced denitrification, erosion and runoff in the top soil, and the dependency of nitrogen on decomposition (Kuhry & Vitt, 1996).

Comprehensive fiber content measurements and comparison with other soil properties

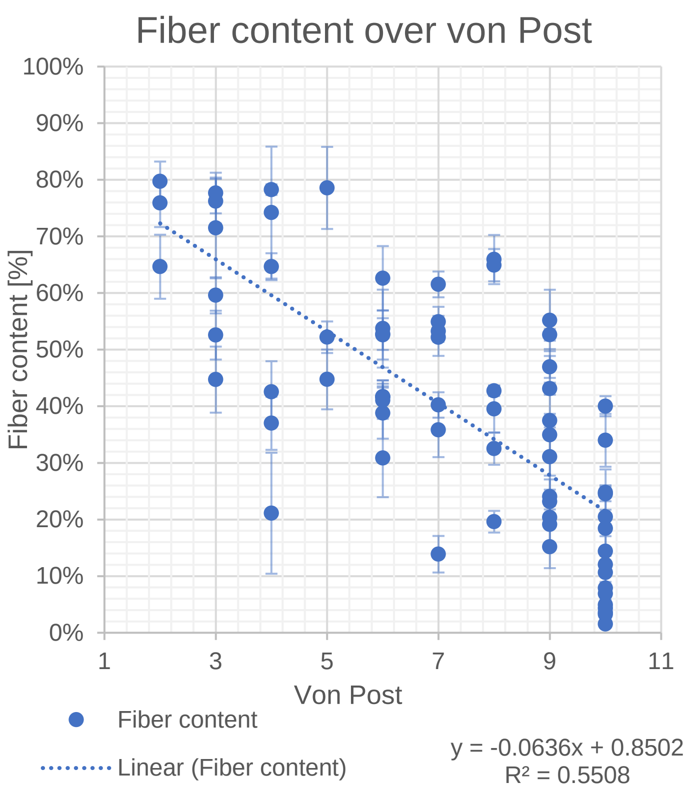

Figure 12 Fiber content [%] over the von Post -value.

The results gathered from the FC measurements show that the FC values are highly variable, not only at different locations and depths, but within the same depth range as well, as is shown in Figure 11. In the chart it is visible that the more decomposed surface peats are at the bottom of the scale with the smallest FC. In the top of the chart are usually peats from the range of H2-H6. The deeper peats are somewhat scattered across the top half of the chart with only a few having lower FC than the agricultural substrate mixture. The total range of the FC values is from approximately 2% up to nearly 80%, which is quite wide. Furthermore, the error margins are quite substantial, as even relatively small variations in the dry masses may percentually have a large impact in the final FC results. The peat material itself is very heterogeneous, in some cases causing variation of over 100%.

The low FC of the decomposed surface peats is expected, as the surface peat experiences more aerobic conditions which enables the decom position process to break down the plant matter comprising the fibers, resulting in smaller particles and less fibrous material, while the deep layers are generally substantially less decomposed due to the decomposing process being halted by the anaerobic and acidic conditions. When looking at Figure 11 above, the correlation between FC and decomposition is clearly seen, as the more decomposed peat has substantially less fibers. At the sapric end of the VP spectrum there are still quite a wide range of FC, which in part may be explainable by a high mineral content in some samples, as larger bits of stone and sand may be caught by the sieve.

Furthermore, the location of sampling does not seem to have a meaningful impact on the results. The German samples are scattered throughout the ranks as are the samples from other countries; there are high and low values in each location at the same approximate rate.

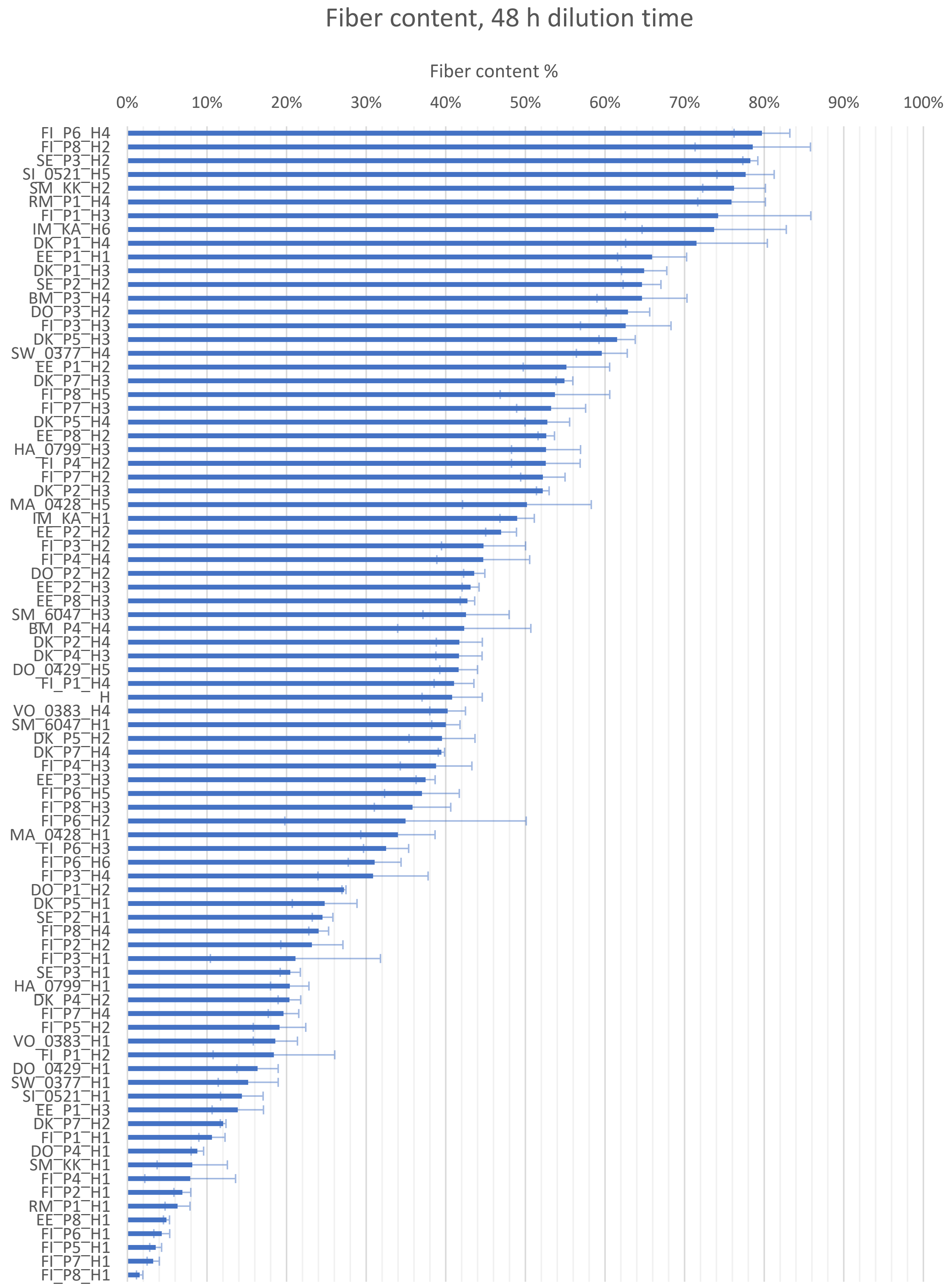

Figure 13 Fiber content [%] results in a descending order.

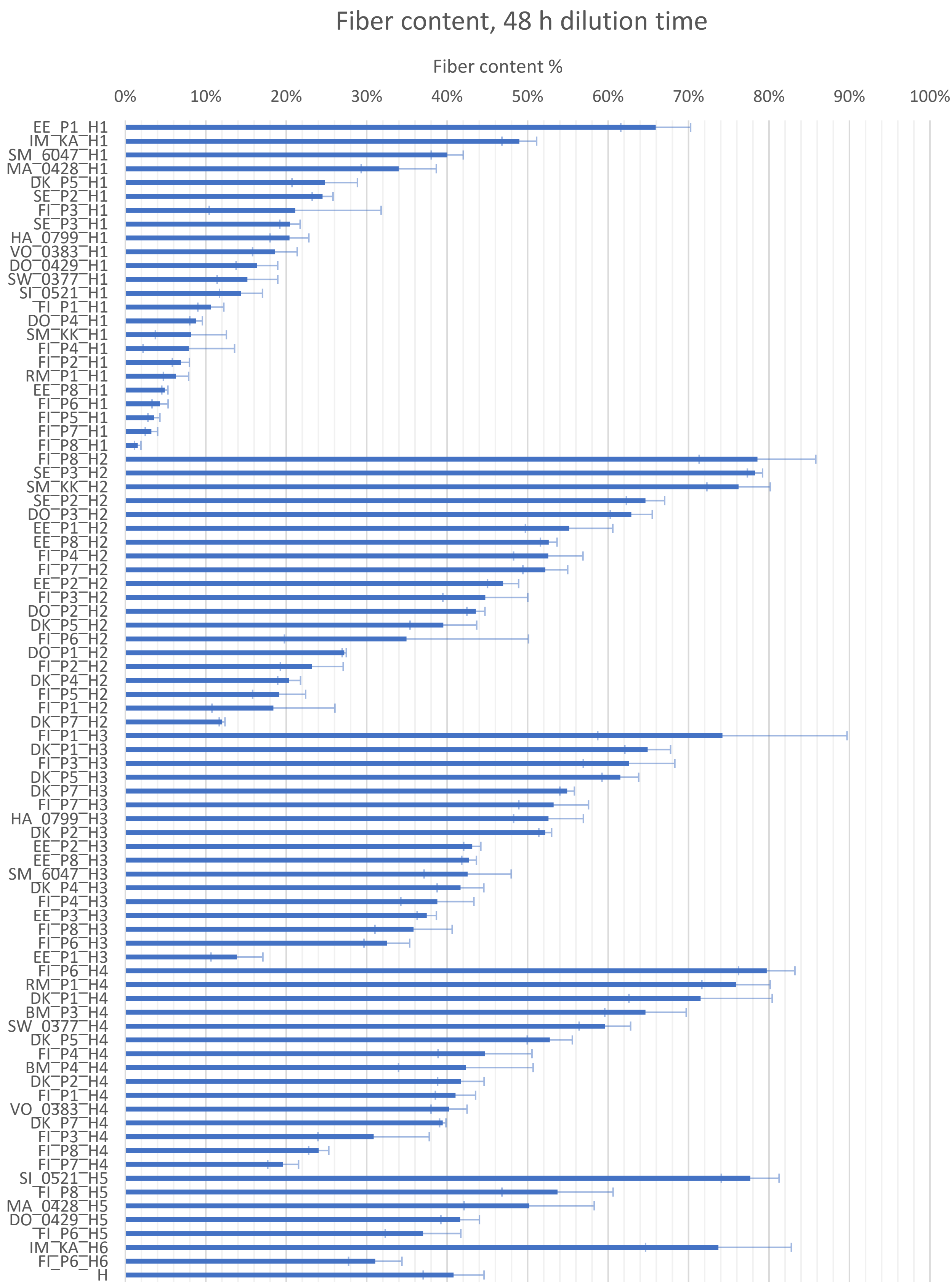

Figure 14 Fiber content [%] results sorted by sampling depth.

Table 4 The fiber content measurement results.

Sample	FC [%]	Sample	FC [%]	Sample	FC [%]
BM_P3_H4	64.65 (± 5.65)	EE_P8_H2	52.62 (± 1.03)	FI_P8_H1	1.54 (± 0.40)
BM_P4_H4	42.32 (± 8.37)	EE_P8_H3	42.72 (± 0.91)	FI_P8_H2	78.57 (± 7.25)
DK_P1_H3	64.92 (± 2.83)	FI_P1_H1	10.62 (± 1.64)	FI_P8_H3	35.82 (± 4.80)
DK_P1_H4	71.50 (± 8.90)	FI_P1_H2	18.41 (± 7.64)	FI_P8_H4	24.03 (± 1.25)
DK_P2_H3	52.19 (± 0.80)	FI_P1_H3	74.21 (± 15.49)	FI_P8_H5	53.72 (± 6.91)
DK_P2_H4	41.70 (± 2.89)	FI_P1_H4	41.03 (± 2.50)	HA_0799_H1	20.40 (± 2.41)
DK_P4_H2	20.35 (± 1.40)	FI_P2_H1	6.91 (± 1.06)	HA_0799_H3	52.59 (± 4.34)
DK_P4_H3	41.66 (± 2.90)	FI_P2_H2	23.17 (± 3.90)	IM_KA_H1	48.96 (± 2.16)
DK_P5_H1	24.78 (± 4.07)	FI_P3_H1	21.11 (± 10.68)	IM_KA_H6	73.72 (± 9.06)
DK_P5_H2	39.53 (± 4.14)	FI_P3_H2	44.74 (± 5.28)	MA_0428_H1	33.99 (± 4.67)
DK_P5_H3	61.52 (± 2.40)	FI_P3_H3	62.61 (± 5.69)	MA_0428_H5	50.19 (± 8.09)
DK_P5_H4	52.75 (± 2.80)	FI_P3_H4	30.86 (± 6.92)	RM_P1_H1	6.30 (± 1.57)
DK_P7_H2	12.03 (± 0.36)	FI_P4_H1	7.89 (± 5.70)	RM_P1_H4	75.90 (± 4.25)
DK_P7_H3	54.91 (± 1.05)	FI_P4_H2	52.57 (± 4.31)	SE_P2_H1	24.52 (± 1.30)
DK_P7_H4	39.45 (± 0.40)	FI_P4_H3	38.78 (± 4.61)	SE_P2_H2	64.65 (± 2.38)
DO_0429_H1	16.35 (± 2.59)	FI_P4_H4	44.71 (± 5.83)	SE_P3_H1	20.46 (± 1.27)
DO_0429_H5	41.61 (± 2.40)	FI_P5_H1	3.55 (± 0.74)	SE_P3_H2	78.26 (± 0.94)
DO_P1_H2	27.21 (± 0.25)	FI_P5_H2	19.11 (± 2.51)	SI_0521_H1	14.38 (± 2.67)
DO_P2_H2	43.57 (± 1.12)	FI_P6_H1	4.32 (± 1.00)	SI_0521_H5	77.66 (± 3.59)
DO_P3_H2	62.88 (± 2.73)	FI_P6_H2	34.94 (± 15.17)	SM_6047_H1	40.01 (± 1.99)
DO_P4_H1	8.79 (± 0.78)	FI_P6_H3	32.50 (± 2.84)	SM_6047_H3	42.55 (± 5.41)
EE_P1_H1	65.92 (± 4.32)	FI_P6_H4	79.72 (± 3.50)	SM_KK_H1	8.15 (± 4.41)
EE_P1_H2	55.16 (± 5.43)	FI_P6_H5	37.00 (± 4.70)	SM_KK_H2	76.22 (± 3.94)

EE_P1_H3	13.87 (± 3.21)	FI_P6_H6	31.06 (± 3.29)	SW_0377_H1	15.18 (± 3.77)
EE_P2_H2	46.95 (± 1.93)	FI_P7_H1	3.25 (± 0.77)	SW_0377_H4	59.60 (± 3.20)
EE_P2_H3	43.12 (± 1.07)	FI_P7_H2	52.20 (± 2.78)	VO_0383_H1	18.59 (± 2.77)
EE_P3_H3	37.47 (± 1.20)	FI_P7_H3	53.24 (± 4.28)	VO_0383_H4	40.23 (± 2.22)
EE_P8_H1	4.91 (± 0.38)	FI_P7_H4	19.61 (± 1.92)	H	40.80 (± 3.78)

FC, TOC and C/N

As can be seen in Figure 16, the TOC is not as strongly influenced by the decomposition as FC. This is most probably due to the long plant fibers being broken into smaller particles and into inorganic components through the decomposition process. The TOC range of values is approximately 17%-57%, while the FC range is approximately 2%-80%, which is a substantial difference in the variance. This could be because while the fibers do break down, the carbons that make up the fibers remain in the soil.

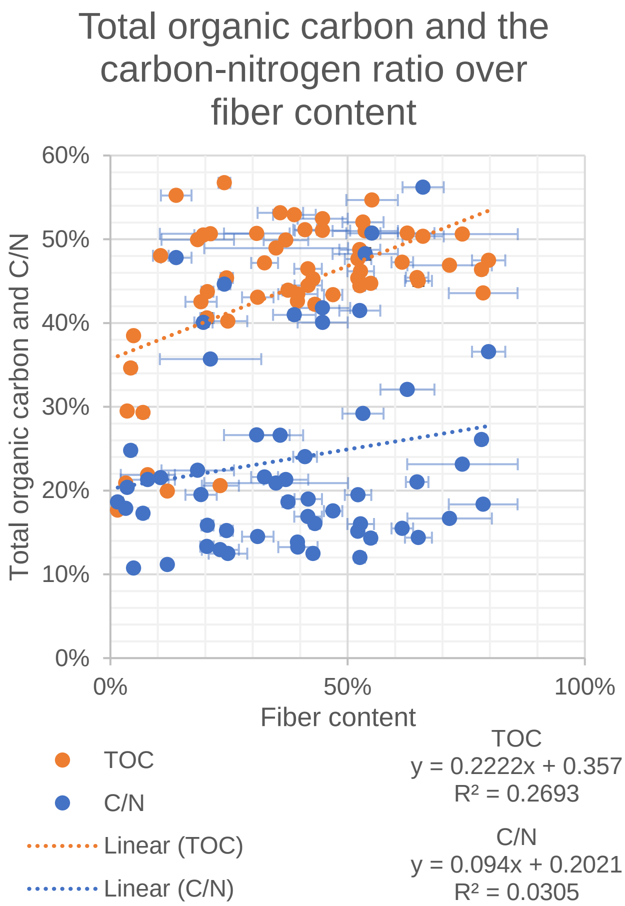

Figure 16 Total organic carbon [%] and Carbon-nitrogen [%] over Fiber content (25 g) [%].

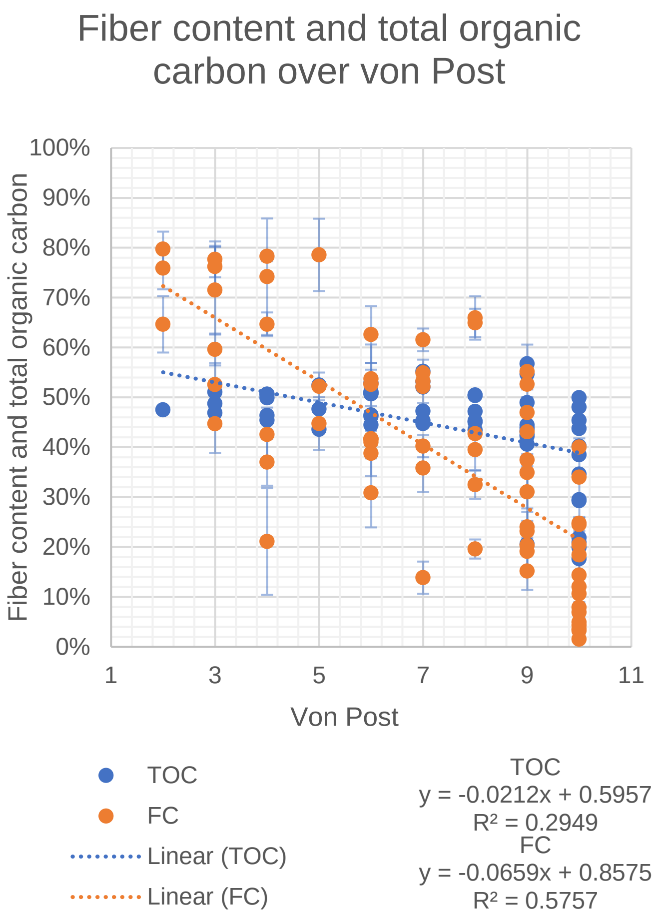

Figure 15 Fiber content (25 g) [%] and total organic carbon [%] over the von Post -value.

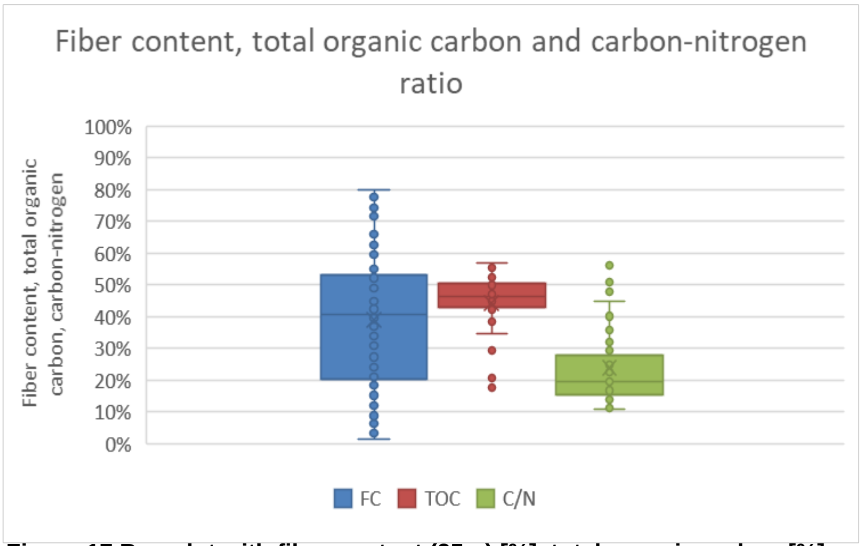

Figure 17 Box plot with fiber content (25 g) [%], total organic carbon [%] and carbon-nitrogen ratio.

As seen in Figure 15 and Figure 17, when the TOC and FC-values are compared to C/N, it seems that they inhabit totally different ranges, as the patterns are nearly inverted with the TOC/C/N ratio being quite low while the FC/C/N ratio is relatively high. The FC-values seem to be less affected by the variance of C/N, as there are high and low values found across all values of C/N. However, most TOC-values are found in the higher ends of C/N. The box plot seems to confirm that the TOC and C/N-values do indeed habit different ranges.

As is seen in Figure 15, as FC lowers, TOC displays a distinct scattering in addition to having lower average values; below 10% FC the values of TOC vary from about 5% to 35%. In contrast at the higher end of TOC/FC the variation of TOC is only from about 44% to 52%. This suggests that while a higher FC more surely correlates to high TOC, the opposite is not as strongly true as the relationship is not as consistent in the reversed direction. This suggests that while highly decomposed peat generally has a low amount if fibers, it may yet have relatively high concentrations of organic carbon, nearly as much as in young peat.

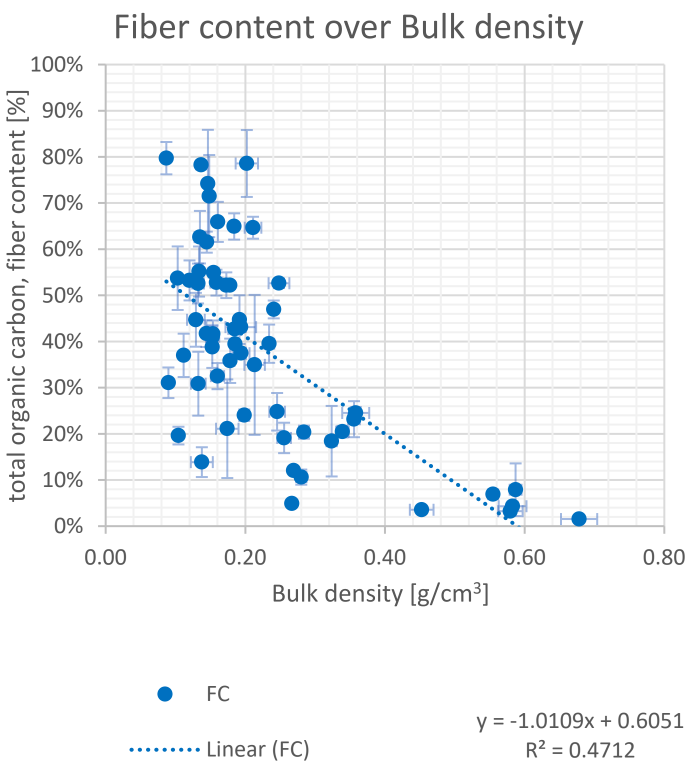

Figure 18 Fiber content [%] over bulk density [g/cm^3]

Bulk density and porosity

When the relationship of FC to BD is evaluated the expected negative relationship between the values is noticeable as is seen in Figure 18. As the BD rises the FC declines extremely

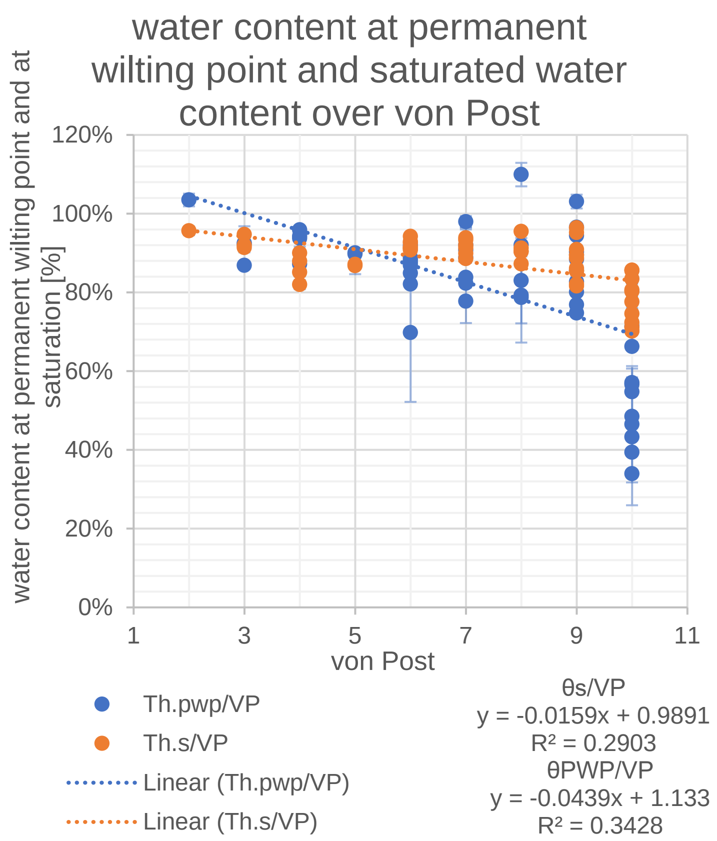

Figure 19 Saturated water content and water content at permanent wilting point [%] over von Post.

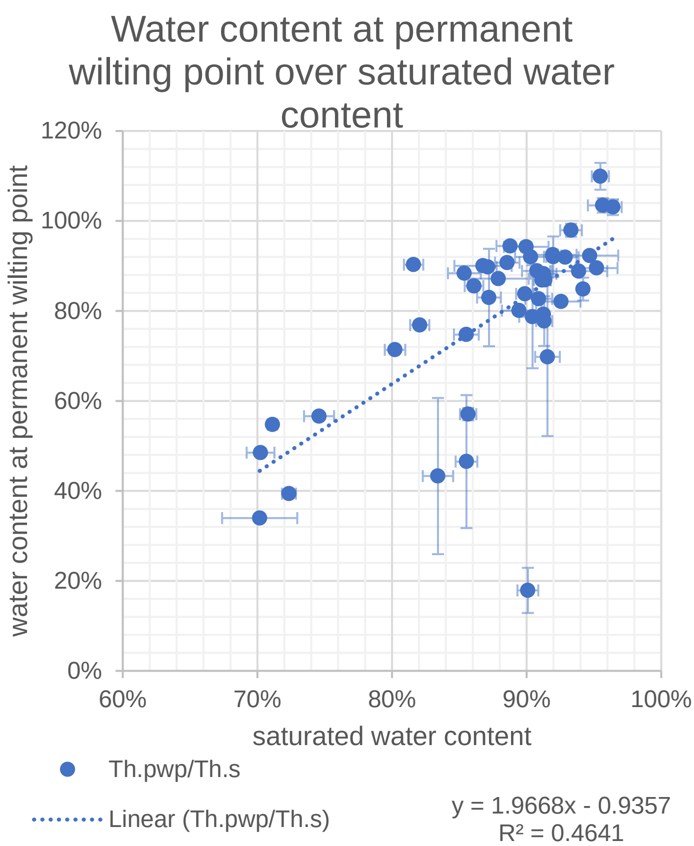

Figure 20 Water content at permanent wilting point [%] over saturated water content [%].

sharply. However the FC is highly scattered in lower densities, as the BD lowers the FC values ranges from around 20% to as high as 80%. At the higher values of BD the variance in FC drops drastically.

15 bar wilting point measurement

As can be seen in the figures below, the permanent wilting point results show that the highest water contents are in the deeper soil horizons, in the range of H4-H6. However, the maximum values do not vary drastically between the soil horizons, but the rise in water content is visible in the approximate average values. What's more, the larges value of θ_{PWP} seems to be above 100% at approximately 110%.

When compared to the level of decomposition the highest values are visibly in the range of 7-9 von Post-values with the highest value of approximately 110% being in the VP category of 8 and the lowest values in the most decomposed category 10. When overlaid and compared with the saturated water content, the similarities are striking. Both values produce the same S-shape, however, θ_{PWP} seems to have a more pronounced curvature as the maximum and minimum values are further from the average. Furthermore, at VP 10 the θ_{PWP} values lie completely below θ_s.

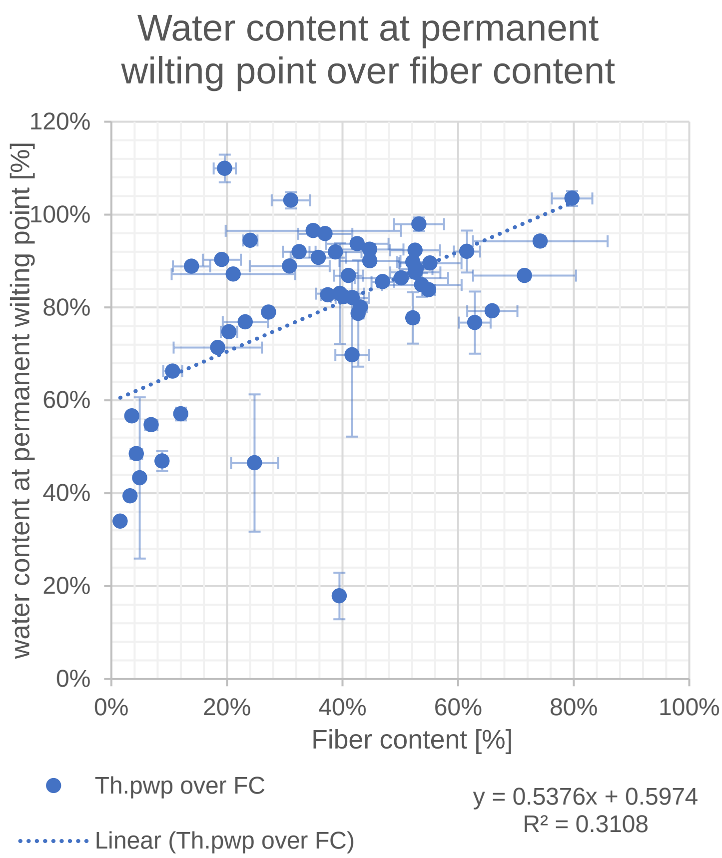

Figure 21 Water content at permanent wilting point [%] over Fiber content [%].

As seen in Figure 20, the water contents at the permanent wilting point and at saturation show some level of correlation with most of the values lying in the ranges of 80% to 100%. Some outliers are visible with the most notable being at approximately θ_{PWP} = 20% and θ_s = 90%, which is the sample DK_P7_H4.

When compared with FC in Figure 21, it is seen that there is a correlation between the values. When the FC lowers, the θ_{PWP} lowers as well. Similar outliers are visible as in figure 20, especially the result of sample DK_P7_H4. The rest of the values land closer to the average with a somewhat sizeable scattering towards the lower values of FC, however.

When looking at the data it is apparent that a high fiber content contributes to the water content and porosity at permanent wilting point, probably through similar reasons as in the case of saturated water content, where fiber structure creates larger and more interconnected pores.

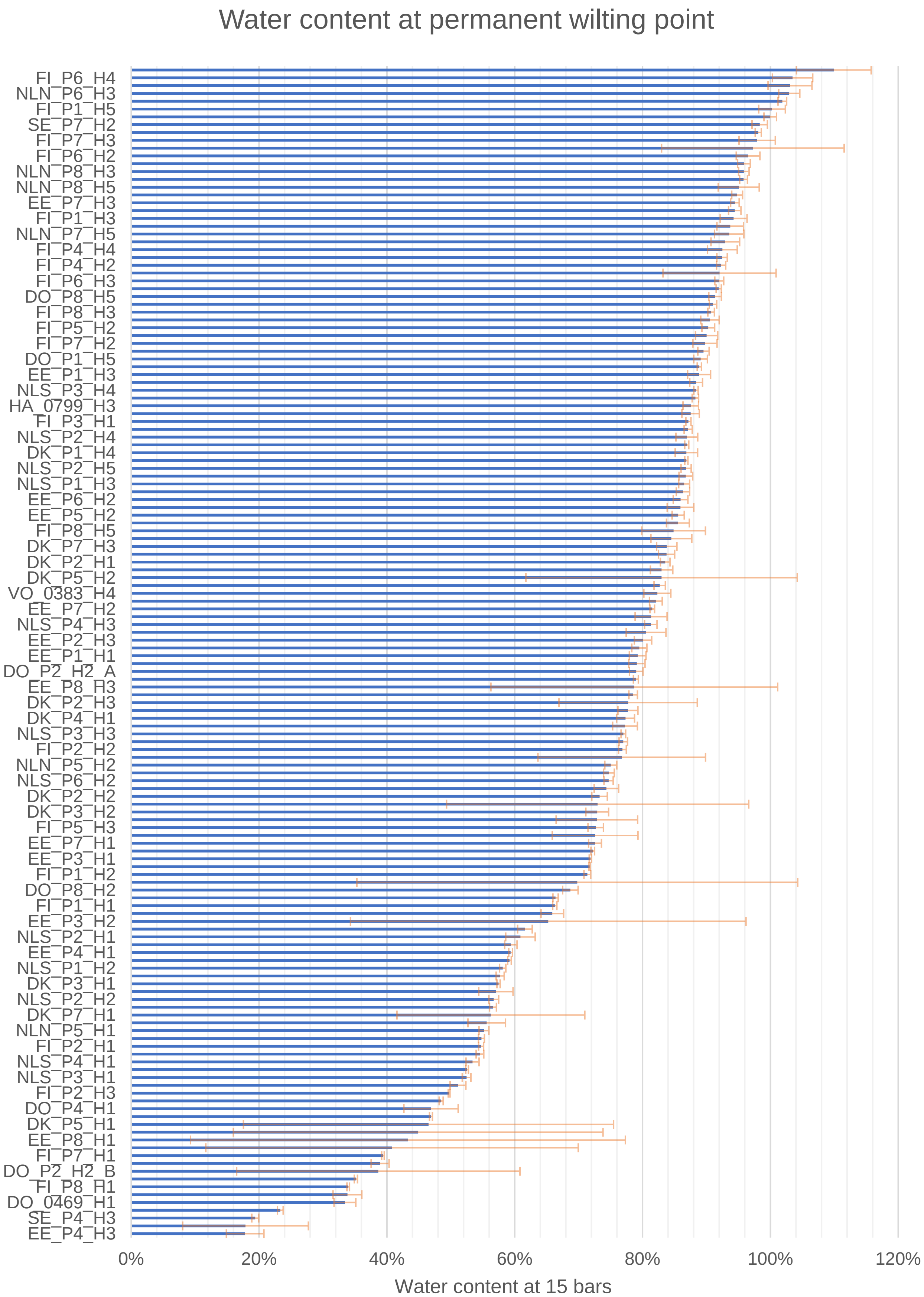

Figure 22 Permanent wilting point water content [%].

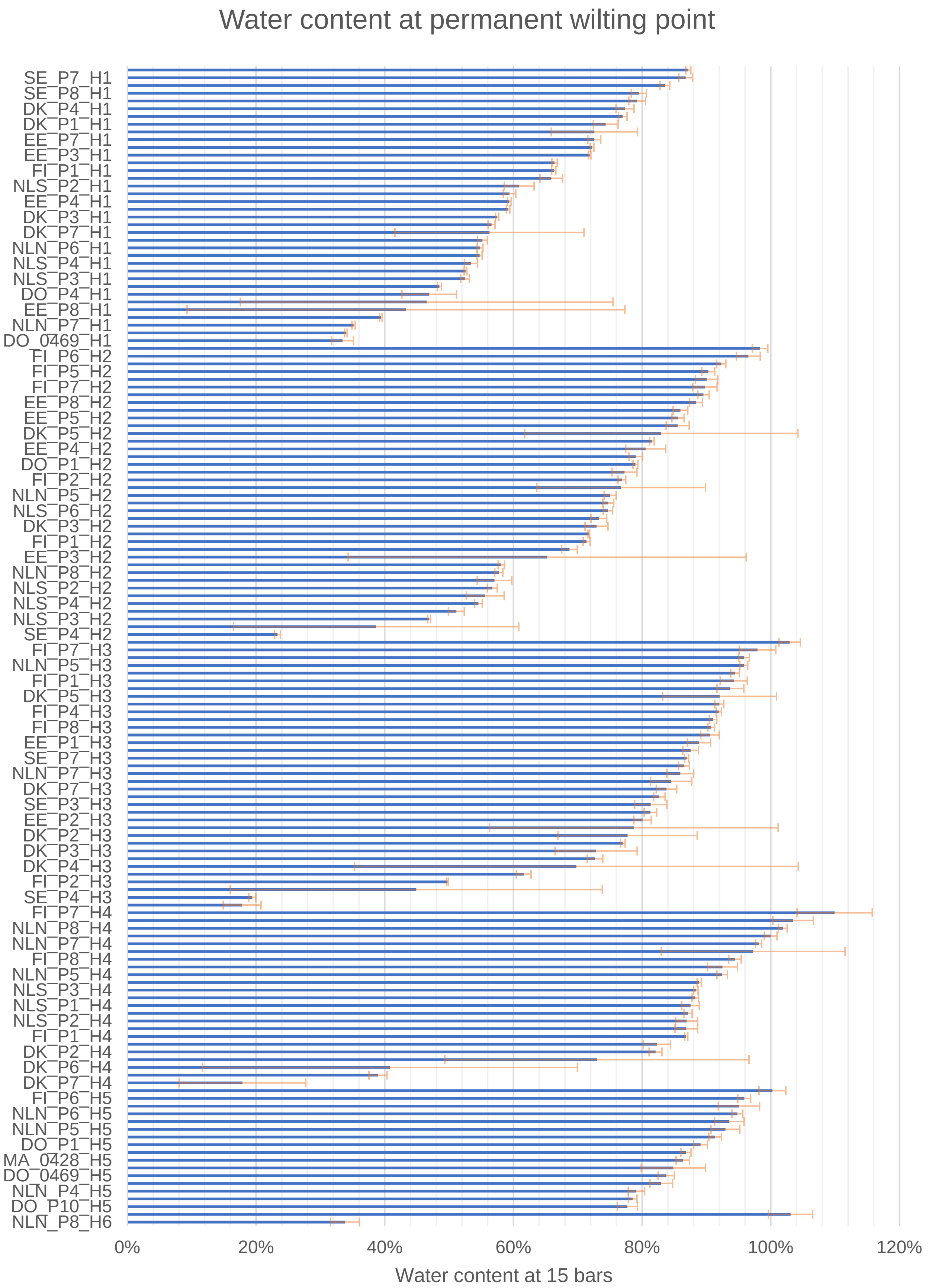

Figure 23 Water content at permanent wilting point [%] sorted by soil horizon.

Methodological uncertainties

Difficulties in the sieving process

Some difficulties were experienced in the sieving and drying of the homogenized peat samples. The sieves that were ordered to be used in the experiments had such a small sieving area that the peat was stacked too high while doing the larger mass samplings (50 and 100 grams), disrupting the flow through the sieve and causing small particles to remain in the sample as well as humidity to be stored inside the sample during the drying phase. This affected the results of the 50 and 100-samples to some degree. This problem was solved by using a wider surface area 1mm sieve to allow for drainage, and by electing the use of smaller, 25-gram sample size.

The storing of soil moisture was detectable by breaking the dry hardened surface of the sample. Doing this revealed a softer, more humid content within, suggesting that the outer layer prevents the insides from drying properly during the 24-hour drying period.

When examining the dried unsieved homogenous samples the phenomenon of hard outer layer was not present. The peat was able to maintain the necessary degree of porosity to allow most of the humidity to escape. However, in the 100-gram sample some humidity was detectable by touch.

In this case all the samples were put back in the oven for approximately 72 hours to ensure uniform drying. The problem did not persist after focusing on 25-gram samples, except for certain types of peat which have a high FC around the 1 mm diameter range, causing blockage even at the 25-gram sample range.

In short, the problems were mostly a mild annoyance and were solved by sacrificing laboratory time into redoing some of the experiments and flushing the samples that clog the sieves enough times to rid the sub-1mm particles.

Methodical error in dilution time

After the methodical experiments the experiments on the natural peats had to be started as soon as possible due to time restrictions. However, the dilution time was not yet set, so the experiments were carried out with 24-hour dilutions, as opposed to 48 hours. This resulted in there being quite a few repetitions being done with basically an imprecise method, leading to redoing of them all. However, as shown in Figure 17 and Table 6 below, as the new results came in it was apparent that the results were not affected as drastically as the homogeneous peat used in the methodical experiments.

The biggest variance between the results is in the sample FI_P1_H4, which has a 48/24 ratio of over 2.8. However, the large gap between the results may not be due to the dilution time, since the sample ran out during the 24-hour dilution time measurement and had to be taken from deepfreeze for the measurement with the 48-hour dilution time. Since the previous amount of sample was from 5°C storage it may have had an effect on the results, e.g. through drying, or by natural heterogeneity.

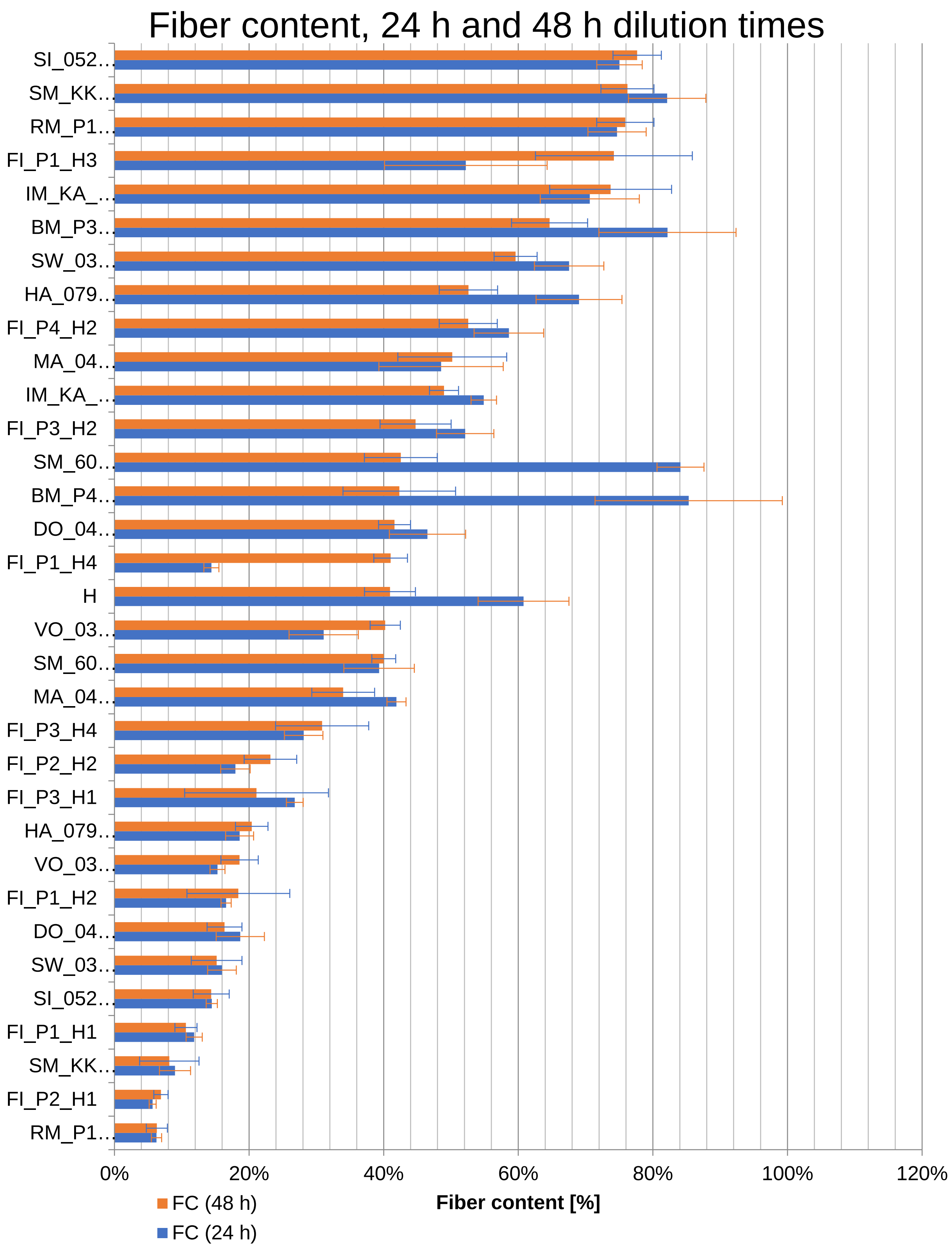

Figure 24 Fiber content [%] of 24 and 48 h dilutions compared, with a descending FC (48 h).

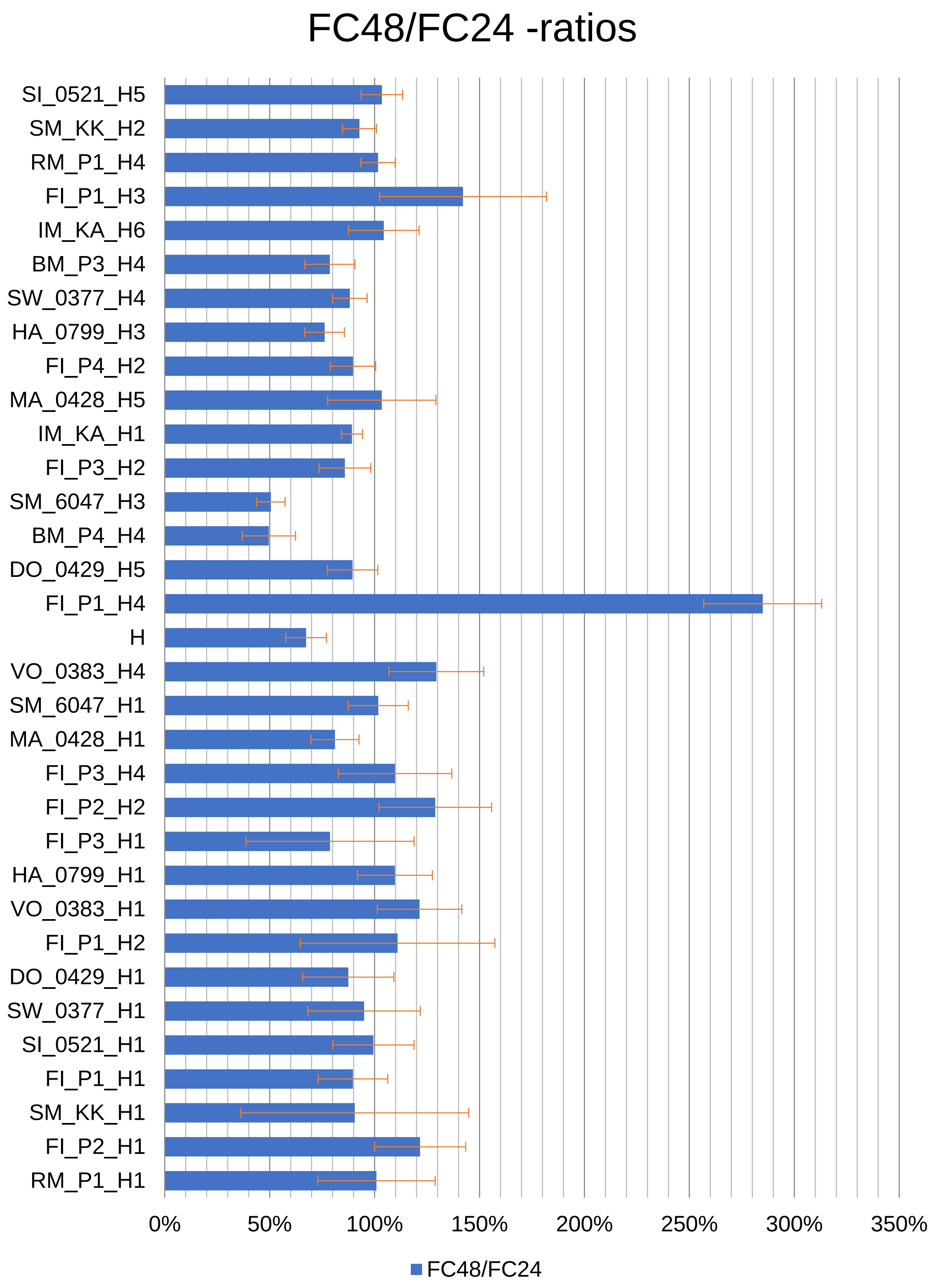

Figure 25 The 48h/24h ratio of the repeated experiments arranged in a descending order.

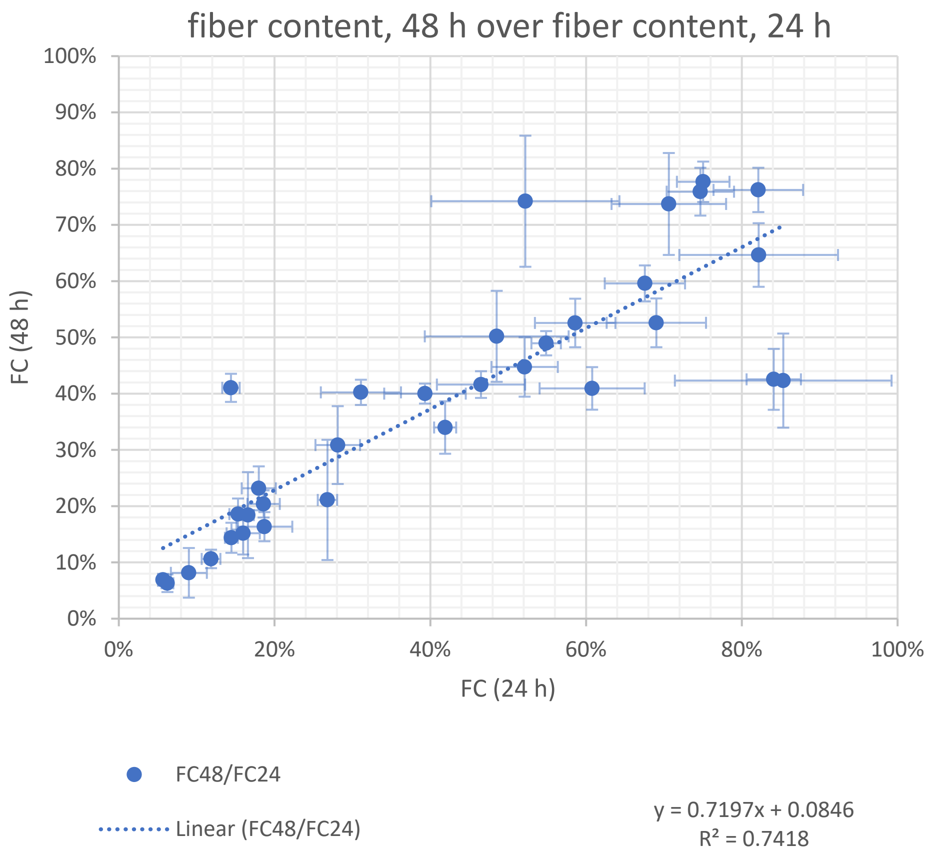

Figure 26 Fiber content (48 h) [%] over fiber content (24 h) [%].

Conclusions

The study was carried out with the aim of proving that fiber content can be used as an objective indicator of the degree of peat decomposition. Considering the correlation between the fiber content results collected in the study and the degree of decomposition found in the pre-existing body of data, it would be appropriate to conclude that fiber content is a reliable and objective indicator of peat decomposition when done with large enough sample sizes and with enough repetitions.

However, due to the equipment, material and time restraints, not enough studies could be done to fully confirm the objectivity of FC as an indicator of decomposition, but the results obtained heavily suggest that is the case. Furthermore, the information on the surrounding flora and fauna, as well as the peatland types, mineral contents as well as anthropologic activities are further helpful in any future studies.

The results found in this study can be used for improving regionalization methods for water levels (Bechtold, ym., 2014) and development of pedotransfer functions for soil hydraulic properties estimations, which would help cut down worktime demands and monetary costs on land characterisation as costly direct measurements could be substituted with predictive methods. Pedotransfer functions are prediction tools for the physical and chemical properties of peat, which require large and reliable databases to work as intended (Wösten;Pachepsky;& Rawls, 2001).

Furthermore, the results can be utilized to support hydrological management strategies for raising water levels in terms of green house gas mitigation, because fiber content is an indicator for peat compressibility (Johari;Bakar;Razali;& Wahab, 2015), and as such an indicator of trafficability for farmers and loggers, as the low bearing capacity of peat is a big problem for foresters, forcing many of the operations to be carried out in the winter (Uusitalo & Ala-Ilomäki, 2013).

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List of abbreviations and acronyms

BD – Bulk Density [g/cm^3]

C/N – Carbon to Nitrogen -ratio [%]

FC – Fiber Content [%]

ΔFC – Difference of Fiber Contents [%]

H – Soil horizon

K_s – Saturated hydraulic conductivity [cm/s]

TOC – Total Organic Carbon [%]

VP – Von-Post

θ_s – Saturated water content [cm^3/cm^3]

θ_{PWP} – water content at permanent wilting point [cm^3/cm^3]

ϕ – Porosity [%]

Appendices

Appendix 1 – List of samples

Sample	Country	City	land use/vegetation	peatland type	peat substrate
BM_P3_H4*	Germany				Sphagnum peat
BM_P4_H4*	Germany				Amorphous peat
SW_0377_H1	Germany		Grünland extensiv/MW		Amorphous peat
SW_0377_H4*	Germany				Sedge peat with reed
MA_0428_H1*	Germany		Grünland intensiv/WI		Amorphous peat
MA_0428_H4	Germany				sedge peat
MA_0428_H5	Germany				Sedge peat with reed
SM_6047_H1	Germany		Grünland intensiv/Saatgrünland		Amorphous peat
SM_6047_H3*	Germany				Sphagnum peat with cotton grass
HA_0799_H1	Germany		GE/MW		Amorphous mixed with mineral soil
HA_0799_H3*	Germany				Sedge peat with cotton grass and Sphagnum
VO_0383_H1	Germany		Grünland/MW		loamy sand with alder
VO_0383_H4	Germany				Alder peat
DO_0429_H1	Germany		Weide (Mutterkuhhaltung), GE/Saatgrünland		loamy sand, amorphous peat
DO_0429_H5	Germany				Sedge peat with alder
SI_0521_H1	Germany		Grünland, extensiv/Phalaris arundinacea, Juncus effusus, Holcus lanatus		amorphous peat with sand
SI_0521_H5	Germany				sedge peat with reed and alder

RM_P1_H1	Germany		Grünland intensiv/Saatgrünland		Sand with amorphous peat
RM_P1_H4	Germany				Sphagnum peat
IM_KA_H1	Germany		N/A		Amorphous peat
IM_KA_H6	Germany		N/A		Sphagnum peat
SM_KK_H1	Germany		Grünland, schafweide/WI		Sand with amorphous peat
SM_KK_H2	Germany				Sphagnum with cotton grass
FI_P1_H1	Finland	Jokioinen	Sown grassland/Grass	fen	Amorphous peat
FI_P1_H2	Finland	Jokioinen	Sown grassland/Grass	fen	Amorphous peat
FI_P1_H3	Finland	Jokioinen	Sown grassland/Grass	fen	sedge peat with reed and birch
FI_P1_H4	Finland	Jokioinen	Sown grassland/Grass	fen	sedge peat with birch and cotton grass
FI_P2_H1	Finland	Humppila	Field/spring wheat	fen	Amorphous peat
FI_P2_H2	Finland	Humppila	Field/spring wheat	fen	sedge peat with birch
FI_P3_H1	Finland	Akaa	Field/oats	bog	Sphagnum peat
FI_P3_H2	Finland	Akaa	Field/oats	bog	birch peat
FI_P3_H3	Finland	Akaa	Field/oats	bog	birch peat
FI_P3_H4	Finland	Akaa	Field/oats	bog	sedge peat with birch
FI_P4_H1	Finland	Akaa	Field/spring barley	bog	Amorphous peat with clay
FI_P4_H2	Finland	Akaa	Field/spring barley	bog	Sphagnum peat with cotton grass and sedges
FI_P4_H3	Finland	Akaa	Field/spring barley	bog	Sedge peat with cotton grass and birches

FI_P4_H4	Finland	Akaa	Field/spring barley	bog	birch peat with cotton grass and sedges
FI_P5_H1	Finland	Akaa	Field/spring barley	fen	Amorphous peat
FI_P5_H2	Finland	Akaa	Field/spring barley	fen	Amorphous peat (some birch remains)
FI_P6_H1	Finland	Forssa	Field/spring barley	fen	Amorphous peat
FI_P6_H2	Finland	Forssa	Field/spring barley	fen	Amorphous peat (some birch remains)
FI_P6_H3	Finland	Forssa	Field/spring barley	fen	sedge peat with birch
FI_P6_H4	Finland	Forssa	Field/spring barley	fen	sedge peat
FI_P6_H5	Finland	Forssa	Field/spring barley	fen	sedge peat
FI_P6_H6	Finland	Forssa	Field/spring barley	fen	sedge peat
FI_P7_H1	Finland	Sastamala	Field/oats	bog	Amorphous peat
FI_P7_H2	Finland	Sastamala	Field/oats	bog	sedge peat
FI_P7_H3	Finland	Sastamala	Field/oats	bog	Cotton grass peat and birch peat
FI_P7_H4	Finland	Sastamala	Field/oats	bog	sedge peat
FI_P8_H1	Finland	Sastamala	Field/oats	fen	Amorphous peat with mineral soil
FI_P8_H2	Finland	Sastamala	Field/oats	fen	sedge peat
FI_P8_H3	Finland	Sastamala	Field/oats	fen	sedge peat
FI_P8_H4	Finland	Sastamala	Field/oats	fen	sedge peat
FI_P8_H5	Finland	Sastamala	Field/oats	fen	sedge peat with cotton grass
DK_P1_H3	Denmark	Tjele	G/WI	fen	reed peat
DK_P1_H4	Denmark	Tjele	G/WI	fen	sedge peat and reed peat

DK_P2_H3	Denmark	Tjele	G/WI	fen	sedge peat with willow and reed
DK_P2_H4	Denmark	Tjele	G/WI	fen	sedge peat with willow and reed
DK_P4_H2	Denmark	Randers	G/Grass	fen	Amorphous peat
DK_P4_H3	Denmark	Randers	G/Grass	fen	sedge peat with reed
DK_P5_H1	Denmark	Randers	G/Grass	fen	Amorphous peat
DK_P5_H2	Denmark	Randers	G/Grass	fen	sedge peat
DK_P5_H3	Denmark	Randers	G/Grass	fen	sedge peat and reed peat
DK_P5_H4	Denmark	Randers	G/Grass	fen	sedge peat and reed peat
DK_P7_H2	Denmark	Tjele	G/Grass	fen	Amorphous peat
DK_P7_H3	Denmark	Tjele	G/Grass	fen	fen peat (no further classification)
DK_P7_H4	Denmark	Tjele	G/Grass	fen	sedge peat with reed
EE_P1_H1	Estonia	Lauka, Sookalduse	Peat cutover/no vegetation	bog	Sphagnum peat with cotton grass and birches
EE_P1_H2	Estonia	Lauka, Sookalduse	Peat cutover/no vegetation	bog	birch peat with cotton grass
EE_P1_H3	Estonia	Lauka, Sookalduse	Peat cutover/no vegetation	bog	sedge peat
EE_P2_H2	Estonia	Sookraavi, Puhtaleiva	Field/spring barley	fen	fen peat (no further classification) with pine
EE_P2_H3	Estonia	Sookraavi, Puhtaleiva	Field/spring barley	fen	sedge peat with pine
EE_P3_H3	Estonia	Sookraavi, Puhtaleiva	Grassland/spring barley	fen	sedge peat with reed and alder
EE_P8_H1	Estonia	Sorgsepa, Reola	Grassland/Grass	fen	sedge peat
EE_P8_H2	Estonia	Sorgsepa, Reola	Grassland/Grass	fen	Amorphous peat

EE_P8_H3	Estonia	Sorgsepa, Reola	Grassland/Grass	fen	sedge peat with birch
SE_P2_H1	Sweden		A/AA (no vegetation)	fen	sedge peat with reed
SE_P2_H2	Sweden		A/AA (no vegetation)	fen	sedge peat with reed
SE_P3_H1	Sweden		A/WG	fen	
SE_P3_H2	Sweden		A/WG	fen	
DO_P1_H2	Germany				
DO_P2_H2	Germany				sedge peat
DO_P3_H2	Germany				
DO_P4_H1	Germany				

*Used in experiment 1

Appendix 2 – the raw results

Sample	Initial weight [g]	Dry weight, sieved [g]	Dry%, sieved	Initial weight, control [g]	dry weight, control [g]	Dry%, control
H	50.1	7.56	15.09%	50.08	13.51	26.98%
H	50.02	8.36	16.71%	49.89	13.52	27.10%
H	50.31	8.86	17.61%	50.02	13.53	27.05%
H	100.25	16.57	16.53%	99.94	27.64	27.66%
H	100.19	15.53	15.50%	99.98	27.68	27.69%
H	100.65	15.33	15.23%	100.05	27.7	27.69%
H	25.14	4.82	19.17%	25.1	8.2	32.67%
H	25.07	5.14	20.50%	24.89	8.19	32.90%
H	25.09	4.96	19.77%	25.04	8.15	32.55%
H	25.14	4.82	19.17%	25.1	8.2	32.67%
H	25.07	5.14	20.50%	24.89	8.19	32.90%
H	25.09	4.96	19.77%	25.04	8.15	32.55%
H	25.14	3.43	13.64%	25.1	8.2	32.67%
H	25.31	3.62	14.30%	24.89	8.19	32.90%
H	24.96	3.63	14.54%	25.04	8.15	32.55%
H	25	3.12	12.48%	25.1	8.2	32.67%
H	25.22	3.52	13.96%	24.89	8.19	32.90%
H	24.93	3.39	13.60%	25.04	8.15	32.55%
H	25.15	3.08	12.25%	25.1	8.2	32.67%
H	25.15	3.58	14.23%	24.89	8.19	32.90%
H	25.14	3.53	14.04%	25.04	8.15	32.55%

BM_P3_H4	25	1.61	6.44%	25	1.9	7.60%
BM_P3_H4	25.15	1.8	7.16%	24.95	1.74	6.97%
BM_P3_H4	25.11	1.64	6.53%	25.07	1.87	7.46%
BM_P3_H4	49.98	2.54	5.08%	49.91	3.66	7.33%
BM_P3_H4	50.28	2.56	5.09%	50.05	3.46	6.91%
BM_P3_H4	50.26	2.74	5.45%	50.03	3.62	7.24%
BM_P4_H4	25.03	1.73	6.91%	25.03	2.18	8.71%
BM_P4_H4	24.94	1.52	6.09%	25.02	2.16	8.63%
BM_P4_H4	25.16	1.51	6.00%	25.14	2.26	8.99%
BM_P4_H4	50.11	4.66	9.30%	50.08	4.74	9.46%
BM_P4_H4	50.058	4.06	8.11%	49.99	4.4	8.80%
BM_P4_H4	49.87	4.65	9.32%	50.13	4.52	9.02%
SW_0377_H4	25.01	2.5	10.00%	24.67	3.2	12.97%
SW_0377_H4	25.01	2.41	9.64%	24.97	3.22	12.90%
SW_0377_H4	24.97	1.98	7.93%	24.9	3.25	13.05%
SW_0377_H4	50.02	4.34	8.68%	49.83	6.49	13.02%
SW_0377_H4	49.98	4.29	8.58%	49.83	6.49	13.02%
SW_0377_H4	49.97	3.93	7.86%	49.83	6.49	13.02%
MA_0428_H1	25.07	4.03	16.07%	25.03	9.9	39.55%
MA_0428_H1	25.01	3.97	15.87%	25.18	9.98	39.63%
MA_0428_H1	25.06	4.21	16.80%	25.02	9.86	39.41%
MA_0428_H1	50.01	8.12	16.24%	50.11	19.87	39.65%
MA_0428_H1	50.06	8.91	17.80%	50.11	19.87	39.65%
MA_0428_H1	50.12	8.4	16.76%	50.11	19.87	39.65%
SM_6047_H3	25.47	3.68	14.45%	25.06	4.27	17.04%

SM_6047_H3	25.33	3.48	13.74%	24.91	4.32	17.34%
SM_6047_H3	25.02	3.52	14.07%	24.96	4.48	17.95%
SM_6047_H3	50.06	7.25	14.48%	50.1	8.6	17.17%
SM_6047_H3	50.3	7.79	15.49%	50.1	8.6	17.17%
SM_6047_H3	49.76	7.51	15.09%	50.1	8.6	17.17%
HA_0799_H3	25.13	2.79	11.10%	25.1	3.46	13.78%
HA_0799_H3	25.01	2.53	10.12%	25.3	3.69	14.58%
HA_0799_H3	25.2	2.92	11.59%	25.54	3.84	15.04%
HA_0799_H3	50.6	4.51	8.91%	50.4	7.43	14.74%
HA_0799_H3	50.75	4.58	9.02%	50.4	7.43	14.74%
HA_0799_H3	50.5	4.92	9.74%	50.4	7.43	14.74%
SW_0377_H1	25.07	0.98	3.91%	25.28	6.67	26.38%
SW_0377_H1	25.2	1.21	4.80%	25.15	6.68	26.56%
SW_0377_H1	25.43	1.01	3.97%	25.29	6.69	26.45%
VO_0383_H1	25.32	1.9	7.50%	25.87	11.98	46.31%
VO_0383_H1	25.74	1.86	7.23%	25.17	11.69	46.44%
VO_0383_H1	25.25	1.67	6.61%	25.67	11.98	46.67%
VO_0383_H4	25.19	1.16	4.61%	25.56	4.55	17.80%
VO_0383_H4	25.75	1.59	6.17%	25.56	4.49	17.57%
VO_0383_H4	25.45	1.44	5.66%	25.7	4.5	17.51%
MA_0428_H4	25.77	1.31	5.08%	25.41	3.87	15.23%
MA_0428_H4	25.45	1.28	5.03%	24.97	3.77	15.10%
MA_0428_H4	25.5	1.35	5.29%	25.5	4.05	15.88%
MA_0428_H5	25.3	1.8	7.11%	25.57	3.21	12.55%
MA_0428_H5	25.8	1.32	5.12%	25.03	3.06	12.23%

MA_0428_H5	25.28	1.48	5.85%	25.62	3.2	12.49%
DO_0429_H1	25.81	2.53	9.80%	25.79	15.74	61.03%
DO_0429_H1	25.2	3.4	13.49%	24.95	15.26	61.16%
DO_0429_H1	25.22	2.71	10.75%	25.23	15.11	59.89%
DO_0429_H5	25.67	1.45	5.65%	25.55	3.29	12.88%
DO_0429_H5	25.32	1.69	6.67%	25.64	3.29	12.83%
DO_0429_H5	24.89	1.37	5.50%	25.27	3.19	12.62%
SI_0521_H1	25.68	1.31	5.10%	25.21	8.85	35.11%
SI_0521_H1	25.48	1.24	4.87%	25.4	9.01	35.47%
SI_0521_H1	25.28	1.36	5.38%	25.35	9.02	35.58%
SI_0521_H5	25.62	2.21	8.63%	25.5	2.81	11.02%
SI_0521_H5	25.43	2.16	8.49%	25.31	2.86	11.30%
SI_0521_H5	25.26	2.16	8.55%	25.23	3	11.89%
HA_0799_H1	25.61	3.59	14.02%	25	17.09	68.36%
HA_0799_H1	25.45	2.93	11.51%	25.28	17.36	68.67%
HA_0799_H1	24.96	3.15	12.62%	24.9	16.97	68.15%
SM_6047_H1	24.95	4.24	16.99%	25.57	9.47	37.04%
SM_6047_H1	25.2	3.59	14.25%	25.76	9.86	38.28%
SM_6047_H1	25.49	3.51	13.77%	25.4	9.95	39.17%
RM_P1_H1	24.96	1.49	5.97%	25.19	21.7	86.15%
RM_P1_H1	25.12	1.36	5.41%	25.92	22.4	86.42%
RM_P1_H1	25.59	1.23	4.81%	25.72	22.32	86.78%
RM_P1_H4	25.52	2.62	10.27%	25.15	3.23	12.84%
RM_P1_H4	24.43	2.35	9.62%	25.25	3.33	13.19%
RM_P1_H4	25.22	2.5	9.91%	25.66	3.56	13.87%

IM_KA_H1	25.55	4.92	19.26%	24.93	8.61	34.54%
IM_KA_H1	25.14	4.92	19.57%	25.13	8.69	34.58%
IM_KA_H1	25.64	4.77	18.60%	25.35	9.01	35.54%
IM_KA_H6	24.83	1.72	6.93%	25.38	2.31	9.10%
IM_KA_H6	25.11	1.49	5.93%	25.03	2.19	8.75%
IM_KA_H6	25.28	1.51	5.97%	25.18	2.22	8.82%
SM_KK_H1	24.94	1.23	4.93%	25.38	16.89	66.55%
SM_KK_H1	25.1	1.58	6.29%	25.16	17.63	70.07%
SM_KK_H1	25.26	1.95	7.72%	25.38	18.78	74.00%
SM_KK_H2	24.96	3.08	12.34%	25.11	3.84	15.29%
SM_KK_H2	25.44	3.15	12.38%	25.34	3.92	15.47%
SM_KK_H2	25.29	3.45	13.64%	25.07	4	15.96%
FI_P1_H1	25.26	0.87	3.44%	25.18	8.04	31.93%
FI_P1_H1	24.82	0.95	3.83%	25.03	7.89	31.52%
FI_P1_H1	25.35	1.03	4.06%	25.33	8.17	32.25%
FI_P1_H2	25.45	1.27	4.99%	25.18	7.68	30.50%
FI_P1_H2	24.94	1.32	5.29%	25.37	7.84	30.90%
FI_P1_H2	24.8	1.25	5.04%	25.11	7.78	30.98%
FI_P1_H3	25.06	1.96	7.82%	25.05	3.56	14.21%
FI_P1_H3	24.75	1.42	5.74%	25.07	3.7	14.76%
FI_P1_H3	24.95	1.56	6.25%	17.82	1.6	8.98%
FI_P1_H4	25.15	0.64	2.54%	24.92	4.19	16.81%
FI_P1_H4	25.34	0.59	2.33%	25.03	4.18	16.70%
FI_P1_H4	25.06	0.589	2.35%	24.93	4.15	16.65%
FI_P2_H1	25.22	0.79	3.13%	24.94	12.58	50.44%

FI_P2_H1	25.15	0.68	2.70%	25.03	12.64	50.50%
FI_P2_H1	24.94	0.69	2.77%	24.93	12.63	50.66%
FI_P2_H2	25.2	1.4	5.56%	24.63	8.67	35.20%
FI_P2_H2	25.31	1.69	6.68%	24.86	8.75	35.20%
FI_P2_H2	25.04	1.7	6.79%	25.45	9.02	35.44%
FI_P3_H1	25.4	1.46	5.75%	25.22	5.35	21.21%
FI_P3_H1	24.96	1.48	5.93%	25.44	5.45	21.42%
FI_P3_H1	25.24	1.38	5.47%	24.86	5.31	21.36%
FI_P3_H2	25.24	2.88	11.41%	24.96	5.13	20.55%
FI_P3_H2	25.09	2.82	11.24%	25.21	5.3	21.02%
FI_P3_H2	24.91	2.49	10.00%	25.34	5.34	21.07%
FI_P4_H2	25.12	2.21	8.80%	25.31	3.74	14.78%
FI_P4_H2	24.78	1.93	7.79%	25	3.56	14.24%
FI_P4_H2	25.13	2.26	8.99%	24.67	3.61	14.63%
FI_P3_H4	24.7	0.95	3.85%	25.28	3.68	14.56%
FI_P3_H4	25.16	0.99	3.93%	25.07	3.65	14.56%
FI_P3_H4	25.14	1.11	4.42%	25.16	3.59	14.27%
SW_0377_H1	24.84	1.25	5.03%			
SW_0377_H1	24.98	0.89	3.56%			
SW_0377_H1	25.18	0.87	3.46%			
SW_0377_H4	25.12	1.71	6.81%			
SW_0377_H4	25.15	2.12	8.43%			
SW_0377_H4	25.02	1.77	7.07%			
MA_0428_H1	25.25	3.27	12.95%			
MA_0428_H1	25.08	3.17	12.64%			

MA_0428_H1	25.24	3.29	13.03%			
MA_0428_H5	24.91	1.68	6.74%			
MA_0428_H5	25.05	1.69	6.75%			
MA_0428_H5	25.12	1.31	5.21%			
VO_0383_H1	25.1	1.84	7.33%			
VO_0383_H1	25.27	2.32	9.18%			
VO_0383_H1	25.09	2.36	9.41%			
VO_0383_H4	25.43	1.82	7.16%			
VO_0383_H4	25.01	1.85	7.40%			
VO_0383_H4	25.3	1.7	6.72%			
SM_6047_H1	25.21	3.54	14.04%			
SM_6047_H1	25.24	3.86	15.29%			
SM_6047_H1	24.65	3.78	15.33%			
HA_0799_H3	24.7	2.11	8.54%			
HA_0799_H3	25.13	1.8	7.16%			
HA_0799_H3	25.1	1.76	7.01%			
DO_0429_H1	25.15	2.78	11.05%			
DO_0429_H1	24.82	2.08	8.38%			
DO_0429_H1	24.95	2.58	10.34%			
DO_0429_H5	24.97	1.31	5.25%			
DO_0429_H5	25.31	1.42	5.61%			
DO_0429_H5	24.73	1.26	5.10%			
SI_0521_H1	24.91	1.42	5.70%			
SI_0521_H1	25.25	1.37	5.43%			
SI_0521_H1	24.9	1.03	4.14%			

SI_0521_H5	25.18	2.24	8.90%			
SI_0521_H5	25.17	2.25	8.94%			
SI_0521_H5	25.19	2.2	8.73%			
HA_0799_H1	24.92	3.15	12.64%			
HA_0799_H1	24.98	3.42	13.69%			
HA_0799_H1	25.26	3.92	15.52%			
SM_6047_H1	25.11	4.1	16.33%			
SM_6047_H1	25.27	3.84	15.20%			
SM_6047_H1	25.1	3.87	15.42%			
RM_P1_H1	25.1	1.71	6.81%			
RM_P1_H1	25.09	1.24	4.94%			
RM_P1_H1	25.09	1.15	4.58%			
RM_P1_H4	25.15	2.59	10.30%			
RM_P1_H4	25.13	2.45	9.75%			
RM_P1_H4	25.29	2.59	10.24%			
IM_KA_H1	25.23	4.22	16.73%			
IM_KA_H1	24.97	4.18	16.74%			
IM_KA_H1	25.48	4.53	17.78%			
IM_KA_H6	25.23	1.84	7.29%			
IM_KA_H6	25.54	1.65	6.46%			
IM_KA_H6	25.06	1.48	5.91%			
SM_KK_H1	24.75	2.14	8.65%			
SM_KK_H1	25.11	0.82	3.27%			
SM_KK_H1	25.15	1.32	5.25%			
SM_KK_H2	25.43	2.96	11.64%			

SM_KK_H2	25.19	2.91	11.55%			
SM_KK_H2	25.05	3.11	12.42%			
FI_P2_H1	25	0.95	3.80%			
FI_P2_H1	25.25	0.94	3.72%			
FI_P2_H1	25.12	0.74	2.95%			
FI_P2_H2	24.99	2.36	9.44%			
FI_P2_H2	25.22	1.77	7.02%			
FI_P2_H2	25.17	2.03	8.07%			
FI_P3_H1	25.22	0.56	2.22%			
FI_P3_H1	25.21	1.52	6.03%			
FI_P3_H1	25.1	1.32	5.26%			
FI_P3_H2	25.27	2.17	8.59%			
FI_P3_H2	25.02	2.61	10.43%			
FI_P3_H2	25.41	2.29	9.01%			
FI_P1_H1	24.79	0.91	3.67%	25.39	7.88	31.04%
FI_P1_H1	25.25	0.89	3.52%	25.43	8.5	33.43%
FI_P1_H1	24.98	0.71	2.84%	24.91	8.01	32.16%
FI_P1_H2	25.3	1.91	7.55%	25.25	7.8	30.89%
FI_P1_H2	24.95	1.58	6.33%	25.23	7.59	30.08%
FI_P1_H2	24.73	0.85	3.44%	25.4	8	31.50%
FI_P1_H3	24.71	2.38	9.63%	25.2	3.4	13.49%
FI_P1_H3	25.2	2.39	9.48%	24.76	3.32	13.41%
FI_P1_H3	24.95	2.67	10.70%	25.14	3.9	15.51%
FI_P1_H4	25.19	1.64	6.51%	24.87	3.72	14.96%
FI_P1_H4	24.67	1.64	6.65%	25.13	3.93	15.64%

FI_P1_H4	25.12	1.72	6.85%	25.43	4.26	16.75%
FI_P3_H3	25.08	2.97	11.84%	25.22	4.43	17.57%
FI_P3_H3	24.7	2.69	10.89%	24.97	4.25	17.02%
FI_P3_H3	25.31	2.78	10.98%	25.17	4.85	19.27%
FI_P3_H4	25.15	1.08	4.29%	25.14	4.04	16.07%
FI_P3_H4	24.98	1.42	5.68%	25.07	3.93	15.68%
FI_P3_H4	25.17	1.01	4.01%	25.08	3.9	15.55%
FI_P4_H3	25.41	1.36	5.35%	25	3.8	15.20%
FI_P4_H3	25.35	1.4	5.52%	25.12	3.64	14.49%
FI_P4_H3	25.28	1.63	6.45%	25.17	3.77	14.98%
FI_P4_H4	25.31	1.26	4.98%	25.27	2.98	11.79%
FI_P4_H4	24.93	1.2	4.81%	25.1	2.93	11.67%
FI_P4_H4	24.78	1.47	5.93%	24.86	2.91	11.71%
FI_P4_H1	25.06	1.86	7.42%	25.01	14.38	57.50%
FI_P4_H1	25.2	0.64	2.54%	25.36	13.94	54.97%
FI_P4_H1	25.22	0.73	2.89%	25.07	12.66	50.50%
FI_P4_H2	25.28	1.96	7.75%	25.05	3.6	14.37%
FI_P4_H2	24.97	1.77	7.09%	25	3.74	14.96%
FI_P4_H2	25.14	2.05	8.15%	25.22	3.66	14.51%
FI_P5_H1	25.11	0.41	1.63%	25.24	11.89	47.11%
FI_P5_H1	24.96	0.5	2.00%	24.96	11.79	47.24%
FI_P5_H1	25.23	0.35	1.39%	24.75	11.65	47.07%
FI_P5_H2	24.81	1.16	4.68%	25.27	7.18	28.41%
FI_P5_H2	24.64	1.27	5.15%	24.93	7.08	28.40%
FI_P5_H2	25.57	1.34	5.24%	25.41	5.6	22.04%

FI_P6_H1	24.91	0.65	2.61%	24.98	12.68	50.76%
FI_P6_H1	25.01	0.43	1.72%	24.7	12.6	51.01%
FI_P6_H1	25.1	0.57	2.27%	24.89	12.7	51.02%
FI_P6_H2	24.68	3.72	15.07%	25.04	8.84	35.30%
FI_P6_H2	24.62	1.71	6.95%	24.99	8.9	35.61%
FI_P6_H2	24.87	3.82	15.36%	9.04	3.26	36.06%
FI_P6_H3	25.17	1.26	5.01%	24.89	4.05	16.27%
FI_P6_H3	25.02	1.45	5.80%	25.25	4.16	16.48%
FI_P6_H3	25.15	1.31	5.21%	25.13	4.15	16.51%
FI_P6_H4	25.09	1.82	7.25%	24.94	2.23	8.94%
FI_P6_H4	24.84	1.84	7.41%	25.24	2.4	9.51%
FI_P6_H4	24.87	1.88	7.56%	24.94	2.35	9.42%
FI_P6_H5	24.96	1.22	4.89%	25.32	2.93	11.57%
FI_P6_H5	24.93	0.98	3.93%	25.21	3.09	12.26%
FI_P6_H5	25.02	1.11	4.44%	25.01	3	12.00%
FI_P6_H6	25.11	0.72	2.87%	24.85	2.47	9.94%
FI_P6_H6	25.21	0.79	3.13%	24.93	2.55	10.23%
FI_P6_H6	24.92	0.86	3.45%	24.85	2.55	10.26%
FI_P7_H1	25.28	0.37	1.46%	24.88	12.69	51.00%
FI_P7_H1	25.26	0.37	1.46%	25.12	12.84	51.11%
FI_P7_H1	24.68	0.51	2.07%	24.96	12.93	51.80%
FI_P7_H2	25.18	2.58	10.25%	25.18	4.79	19.02%
FI_P7_H2	25.19	2.36	9.37%	25.11	4.75	18.92%
FI_P7_H2	25	2.52	10.08%	25.38	4.81	18.95%
FI_P7_H3	25.14	1.78	7.08%	25.06	3.29	13.13%

FI_P7_H3	24.74	1.79	7.24%	25.08	3.24	12.92%
FI_P7_H3	24.8	1.57	6.33%	24.97	3.18	12.74%
FI_P7_H4	25.08	0.51	2.03%	25.14	2.83	11.26%
FI_P7_H4	25.08	0.59	2.35%	25.27	2.79	11.04%
FI_P7_H4	25.12	0.52	2.07%	25.33	2.69	10.62%
FI_P8_H4	25.1	1.2	4.78%	24.72	4.89	19.78%
FI_P8_H4	24.98	1.24	4.96%	24.95	4.91	19.68%
FI_P8_H4	25.15	1.14	4.53%	25.02	4.99	19.94%
FI_P8_H5	25.26	1.44	5.70%	24.86	2.69	10.82%
FI_P8_H5	25.23	1.34	5.31%	25.37	2.76	10.88%
FI_P8_H5	25.14	1.66	6.60%	24.97	2.77	11.09%
FI_P8_H1	24.73	0.21	0.85%	25.03	14.13	56.45%
FI_P8_H1	24.86	0.17	0.68%	25.02	14.18	56.67%
FI_P8_H1	24.99	0.27	1.08%	24.82	14.04	56.57%
FI_P8_H2	25.03	5	19.98%	25.1	6.56	26.14%
FI_P8_H2	25.07	4.94	19.70%	24.75	6.81	27.52%
FI_P8_H2	24.86	5.54	22.28%	25.1	6.33	25.22%
FI_P8_H3	25.21	1.9	7.54%	25.4	4.74	18.66%
FI_P8_H3	24.88	1.63	6.55%	24.84	4.65	18.72%
FI_P8_H3	25.29	1.51	5.97%	24.98	4.65	18.61%
SW_0377_H4	25.09	1.84	7.33%			
SW_0377_H4	24.82	1.94	7.82%			
SW_0377_H4	24.81	2.09	8.42%			
SW_0377_H4	49.91	3.93	7.87%			
SW_0377_H4	50.17	3.72	7.41%			

SW_0377_H4	50.05	4.28	8.55%			
MA_0428_H1	25.29	3.3	13.05%			
MA_0428_H1	25.42	4.52	17.78%			
MA_0428_H1	25.24	2.85	11.29%			
MA_0428_H1	50.17	6.81	13.57%			
MA_0428_H1	49.77	8.87	17.82%			
MA_0428_H1	49.68	4.45	8.96%			
SM_6047_H3	24.8	1.61	6.49%			
SM_6047_H3	25.06	2.07	8.26%			
SM_6047_H3	25.22	2.32	9.20%			
SM_6047_H3	49.6	3.35	6.75%			
SM_6047_H3	50.25	3.65	7.26%			
SM_6047_H3	49.96	3.1	6.20%			
HA_0799_H3	25.03	2.05	8.19%			
HA_0799_H3	49.74	3.73	7.50%			
DK_P1_H4	25.06	2.35	9.38%	24.76	3.7	14.94%
DK_P1_H4	24.91	2.91	11.68%	25.01	3.7	14.79%
DK_P1_H4	24.79	2.63	10.61%	25.28	3.68	14.56%
DK_P5_H1	25.75	1.1	4.27%	25.04	4.18	16.69%
DK_P5_H1	24.88	1.21	4.86%	24.7	4.2	17.00%
DK_P5_H1	25.06	0.92	3.67%	24.97	4.49	17.98%
DK_P5_H2	25	1.98	7.92%	25.08	5.76	22.97%
DK_P5_H2	25.01	2.28	9.12%	25.03	5.42	21.65%
DK_P5_H2	25.42	2.38	9.36%	24.99	5.54	22.17%
DK_P5_H3	25.3	2.18	8.62%	25.38	3.71	14.62%

DK_P5_H3	25.01	2.28	9.12%	25.14	3.69	14.68%
DK_P5_H3	25.25	2.29	9.07%	24.95	3.56	14.27%
DK_P1_H3	24.5	3.08	12.57%	25.09	4.67	18.61%
DK_P1_H3	25.82	3.03	11.74%	25.41	4.69	18.46%
DK_P1_H3	25.15	2.97	11.81%	25.11	4.66	18.56%
DK_P5_H4	25.03	2	7.99%	24.97	3.63	14.54%
DK_P5_H4	25.34	1.9	7.50%	25.24	3.68	14.58%
DK_P5_H4	24.91	1.83	7.35%	25.41	3.6	14.17%
BM_P3_H4	24.76	1.15	4.64%			
BM_P3_H4	24.8	1.09	4.40%			
BM_P3_H4	49.94	2.51	5.03%			
BM_P4_H4	24.93	0.87	3.49%			
BM_P4_H4	24.92	0.83	3.33%			
BM_P4_H4	49.95	2.26	4.52%			
DK_P2_H3	25.01	2.34	9.36%	25.18	4.54	18.03%
DK_P2_H3	25.31	2.37	9.36%	25.33	4.6	18.16%
DK_P2_H3	24.77	2.37	9.57%	25.31	4.56	18.02%
DK_P2_H4	25.23	1.7	6.74%	25.11	3.8	15.13%
DK_P2_H4	24.63	1.47	5.97%	25.2	3.85	15.28%
DK_P2_H4	24.84	1.59	6.40%	25.05	3.86	15.41%
DK_P4_H2	25.08	1.26	5.02%	24.99	6.04	24.17%
DK_P4_H2	25.07	1.26	5.03%	24.89	5.94	23.87%
DK_P4_H2	25.23	1.14	4.52%	25.32	5.96	23.54%
DK_P4_H3	24.77	1.33	5.37%	25	3.32	13.28%
DK_P4_H3	25.07	1.45	5.78%	24.8	3.21	12.94%

DK_P4_H3	24.87	1.28	5.15%	25.26	3.26	12.91%
DK_P7_H2	25.02	0.783	3.13%	24.86	6.51	26.19%
DK_P7_H2	25.19	0.81	3.22%	25.28	6.58	26.03%
DK_P7_H2	24.88	0.76	3.05%	24.72	6.41	25.93%
DK_P7_H3	24.91	2.3	9.23%	24.91	4.23	16.98%
DK_P7_H3	25.4	2.31	9.09%	24.86	4.12	16.57%
DK_P7_H3	25.25	2.35	9.31%	25.22	4.23	16.77%
DK_P7_H4	25.14	1.86	7.40%	25.1	4.68	18.65%
DK_P7_H4	24.94	1.83	7.34%	25.25	4.76	18.85%
DK_P7_H4	24.92	1.84	7.38%	25.31	4.7	18.57%
EE_P1_H1	25.21	3.11	12.34%	25.03	4.92	19.66%
EE_P1_H1	25.08	3.47	13.84%	25.14	4.97	19.77%
EE_P1_H1	25.16	3.26	12.96%	25.08	5	19.94%
EE_P1_H2	25.06	2.16	8.62%	24.83	3.6	14.50%
EE_P1_H2	24.99	2.07	8.28%	24.71	3.62	14.65%
EE_P1_H2	25.15	1.83	7.28%	24.78	3.64	14.69%
EE_P1_H3	25	0.59	2.36%	24.98	3.44	13.77%
EE_P1_H3	25.02	0.45	1.80%	24.93	3.38	13.56%
EE_P1_H3	24.92	0.4	1.61%	25.37	3.61	14.23%
EE_P2_H2	24.98	4.12	16.49%	24.9	8.67	34.82%
EE_P2_H2	24.86	4.24	17.06%	25.23	8.9	35.28%
EE_P2_H2	25.13	3.99	15.88%	25.01	8.8	35.19%
EE_P2_H3	25.13	2.69	10.70%	25.08	6.27	25.00%
EE_P2_H3	25.08	2.66	10.61%	25.14	6.27	24.94%
EE_P2_H3	24.98	2.76	11.05%	24.81	6.23	25.11%

EE_P3_H3	24.77	1.9	7.67%	25.17	5.01	19.90%
EE_P3_H3	25.06	1.82	7.26%	25.34	5.01	19.77%
EE_P3_H3	25.28	1.88	7.44%	24.81	4.97	20.03%
EE_P8_H1	24.89	0.32	1.29%	25.14	7.14	28.40%
EE_P8_H1	25.14	0.36	1.43%	25.38	7.18	28.29%
EE_P8_H1	25.25	0.37	1.47%	24.86	7.09	28.52%
EE_P8_H2	25.19	3.23	12.82%	24.9	5.97	23.98%
EE_P8_H2	25.17	3.12	12.40%	25.26	6.07	24.03%
EE_P8_H2	25.06	3.18	12.69%	25.01	6.01	24.03%
EE_P8_H3	25.26	2.04	8.08%	25.41	4.8	18.89%
EE_P8_H3	25.2	2	7.94%	25.08	4.75	18.94%
EE_P8_H3	25	2.06	8.24%	24.82	4.7	18.94%
SE_P2_H1	25.01	2.55	10.20%	25.39	10.72	42.22%
SE_P2_H1	25.18	2.77	11.00%	25.38	10.85	42.75%
SE_P2_H1	24.97	2.53	10.13%	25.28	10.82	42.80%
SE_P2_H2	24.9	6.85	27.51%	24.81	10.28	41.43%
SE_P2_H2	25	6.82	27.28%	25.12	10.47	41.68%
SE_P2_H2	24.9	6.45	25.90%	24.75	10.32	41.70%
SE_P3_H1	25.22	2.15	8.52%	25.05	10.67	42.59%
SE_P3_H1	24.7	2.29	9.27%	25.11	10.72	42.69%
SE_P3_H1	24.81	2.08	8.38%	24.94	10.64	42.66%
SE_P3_H2	24.86	5.05	20.31%	24.7	6.34	25.67%
SE_P3_H2	25.04	4.98	19.89%	24.69	6.35	25.72%
SE_P3_H2	25.3	5.09	20.12%	25.3	6.5	25.69%
DO_P1_H2	25.18	2.41	9.57%	24.69	8.61	34.87%

DO_P1_H2	24.76	2.37	9.57%	25.15	8.83	35.11%
DO_P1_H2	24.75	2.36	9.54%	25.01	8.86	35.43%
DO_P2_H2	24.8	3.56	14.35%	25.05	8.48	33.85%
DO_P2_H2	25.12	3.59	14.29%	24.836	8.07	32.49%
DO_P2_H2	24.73	3.65	14.76%	25.04	8.33	33.27%
DO_P3_H2	24.76	1.93	7.79%	24.82	3.2	12.89%
DO_P3_H2	24.98	1.96	7.85%	24.57	3.12	12.70%
DO_P3_H2	24.7	2.05	8.30%	25	3.12	12.48%
DO_P4_H1	24.65	1.03	4.18%	25.41	11.03	43.41%
DO_P4_H1	25.09	0.9	3.59%	24.56	10.89	44.34%
DO_P4_H1	24.82	0.94	3.79%	24.98	10.91	43.67%

Appendix 3 – the repeated 25-gram natural peat experiments

Table 5 Results of the repeated FC measurements, 24 and 48-hour dilution times, as well as the 48h/24h ratio.

Sample	FC (24 h) [%]	FC (48 h) [%]	FC48/FC24
BM_P3_H4	82.16 (± 10.19)	64.65 (± 5.65)	0.787 (± 0.119)
BM_P4_H4	85.32 (± 13.91)	42.32 (± 8.37)	0.496 (± 0.127)
DO_0429_H1	18.69 (± 3.58)	16.35 (± 2.59)	0.875 (± 0.217)
DO_0429_H5	46.51 (± 5.68)	41.61 (± 2.40)	0.895 (± 0.121)
FI_P1_H1	11.84 (± 1.20)	10.62 (± 1.64)	0.897 (± 0.166)
FI_P1_H2	16.59 (± 0.76)	18.41 (± 7.64)	1.110 (± 0.463)
FI_P1_H3	52.20 (± 14.05)	74.21 (± 15.49)	1.421 (± 0.484)
FI_P1_H4	14.40 (± 1.12)	41.03 (± 2.50)	2.849 (± 0.281)
FI_P2_H1	5.67 (± 0.52)	6.91 (± 1.06)	1.217 (± 0.217)
FI_P2_H2	17.97 (± 2.19)	23.17 (± 3.90)	1.289 (± 0.268)
FI_P3_H1	26.79 (± 1.24)	21.11 (± 10.68)	0.788 (± 0.400)
FI_P3_H2	52.11 (± 4.26)	44.74 (± 5.28)	0.859 (± 0.123)
FI_P3_H4	28.11 (± 2.86)	30.86 (± 6.92)	1.098 (± 0.270)
FI_P4_H2	58.60 (± 5.17)	52.57 (± 4.31)	0.897 (± 0.108)
H	60.78 (± 6.75)	40.93 (± 3.78)	0.673 (± 0.097)
HA_0799_H1	18.59 (± 2.08)	20.40 (± 2.41)	1.097 (± 0.178)
HA_0799_H3	69.02 (± 6.38)	52.59 (± 4.34)	0.762 (± 0.094)
IM_KA_H1	54.87 (± 1.89)	48.96 (± 2.16)	0.892 (± 0.050)
IM_KA_H6	70.63 (± 7.35)	73.72 (± 9.06)	1.044 (± 0.168)
MA_0428_H1	41.90 (± 1.42)	33.99 (± 4.67)	0.811 (± 0.115)
MA_0428_H5	48.53 (± 9.24)	50.19 (± 8.09)	1.034 (± 0.258)
RM_P1_H1	6.24 (± 0.76)	6.30 (± 1.57)	1.009 (± 0.280)

RM_P1_H4	74.67 (± 4.33)	75.90 (± 4.25)	1.016 (± 0.082)
SI_0521_H1	14.46 (± 0.83)	14.38 (± 2.67)	0.994 (± 0.193)
SI_0521_H5	75.04 (± 3.38)	77.66 (± 3.59)	1.035 (± 0.067)
SM_6047_H1	39.32 (± 5.31)	40.01 (± 1.99)	1.018 (± 0.146)
SM_6047_H3	84.10 (± 3.49)	42.55 (± 5.41)	0.506 (± 0.068)
SM_KK_H1	9.00 (± 2.31)	8.15 (± 4.41)	0.906 (± 0.543)
SM_KK_H2	82.12 (± 5.75)	76.22 (± 3.94)	0.928 (± 0.081)
SW_0377_H1	15.97 (± 2.13)	15.18 (± 3.77)	0.950 (± 0.268)
SW_0377_H4	67.55 (± 1.11)	59.60 (± 3.20)	0.882 (± 0.082)
VO_0383_H1	15.31 (± 5.14)	18.59 (± 2.77)	1.214 (± 0.201)
VO_0383_H4	31.09 (± 0.19)	40.23 (± 2.22)	1.294 (± 0.342)