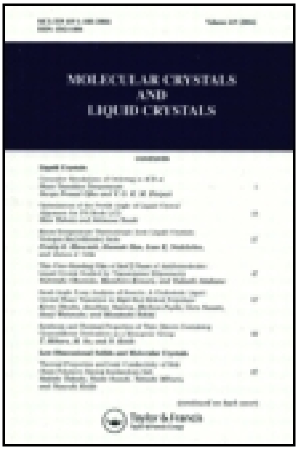

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Frost Processed Reed Canary Grass In Oil Spill Absorption

Antti Pasila [a] & Hanna-Riitta Kymäläinen [a]

[a] University of Helsinki, Department of Agricultural Engineering and Household Technology, P.O. Box 27 FIN-00014 University of Helsinki, Finland

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Frost Processed Reed Canary Grass In Oil Spill Absorption

ANTTI PASILA* and HANNA-RIITTA KYMÄLÄINEN

University of Helsinki, Department of Agricultural Engineering and Household Technology, P.O. Box 27 FIN-00014 University of Helsinki, Finland

In this research the yield of Reed Canary Grass (RCG) was harvested in spring after a Nordic winter. During the winter frost and ice cause damage the cell structure of plants. RCG has a very high concentrtion of silicate, mainly in the leaves ofthe plant (1).

The plant material was hammermilled with a 12 mm screen. Then the powder was sifted with a 0,7 mm sieve and the underflow of the sieve was used in oil absorption tests.

There are obviously several reasons for the absorption of hydrocarbons in RCG-powder. This problem is studied in a licenciate thesis by the author of this text. The main reasons for the oil absorption phenomena seem to be:

- The adsorption and colloid action of the small particles in the powder and liquids
- The capillary absorption of oil in the perforated and empty ice-broken cells
- The effect on small diameter silicate particles on flocculation of oil droplets
- The effect on silicate compounds in bulk oil viscosity and flux in a RCG filter

The amount and effects of silicate was studied by different methods. The oil absorption capacity on the RCG-powder was measured. The concentration of ash and silicate was measured in different fractions of a standard sieve (2). Also the viscosity of oil was measured with different RCG powder and ash concentrations.

Keywords: absorption; dry-line; frost; reed canary grass; oil spill; silicate

* Antti.Pasila@helsinki.fi

1. INTRODUCTION

Reed Canary Grass (RCG) (Phalaris arundinacea) was used in a research as raw material for pulp and paper (3). In this research the yield was harvested in the following spring after the growing when the moisture contents was very low (appr. 10-15% w.b.) This harvesting method has been tested in University of Helsinki since 1991. First in the RCG harvesting and later also as **dry-line -method®** (4) for flax and hemp. In the dry-line -method the seeds of fibre plants are harvested in autumn but the straw is harvested in spring when it is dry and well retted.

As a raw material for paper RCG caused in the firstsome problems because of its high silicate contents. Silicate was stucked in some of the pulp mill pipelines. This problem was solved by separating the high silicate concentrate leaves into a different fraction (3). This fraction turned out to be a useful material in absorption of oil spills (5).

There is a connection between the non-wood pulp production areas and increaese of oil consumption in the world (TABLE 1). Asia and China are areas where e.g. reed canary grass could be produced for both pulp production and oil spill absorption

TABLE 1. Oil consumption in the world, in crude oil (milj. tonnes) (6).

Area	1971	1978	1993	1996
World total	2 381	3 091	3 170	3 316
North America	825	1 035	943	994
Asia+China	115	214	396	476
OECD (Europe)	675	757	674	706
Finland	11	13	10	10

The oil consumption in the whole world has increased by 40 % during 25 yers, from 1971 to 1996. However the highest procentage growth of consumption has taken place in Asia and China it has been appr 300 % in 25 years. The oil consumption is in the growth still in these areas so it is obvious the highest increase in oil consumpion is in the near future. In all discharge cases more attention should be paid to stop the oil spreading as early as possible because the properties of oil include a hysteresis phenomena; after the oil has polluted an aquifer the cleanup is slow and expensive.

2. PROCESSING OF THE RCG PLANT MATERIAL

The yield of RCG was harvested both in autumn in September and in spring in April or May. The moisture content of autumn harvested yield was so high that it had to be dried in a hay drier. The spring harvested material needed no drying. At the end the moisture content of the stored RCG was 8 - 10 % w.b.

As a reference in the tests there were also samples producted from processed hemp shives. The methods for harvesting and processing were the same as with RCG. The moisture content of hemp in autumn was even higher than when harvesting RCG. Spring- or dry-line-harvested hemp needed no drying. The moisture content was 8 -10 %w.b.

The dried RCG stems were pulverised with a "KAMAS" 30 kW hammermill with a 12 mm Ø screen. After that the pulverised material was sifted with a rotary screen with first 7 mm Ø screen and later on with a 0,7 mm Ø screen. The samples were also tested in a standard sieve equipment. The sizes of the standard sieve were not exactly same as in the rotary screen (FIGURE 1). The fractions which were used in the filtration tests were nearest the std sieve fractions between 35 and end and using sieving time 80 s.

One problem in the screening is the two peak distribution in the sieving results. The different fractions of a fiber plant seem to have different rheology in the process.

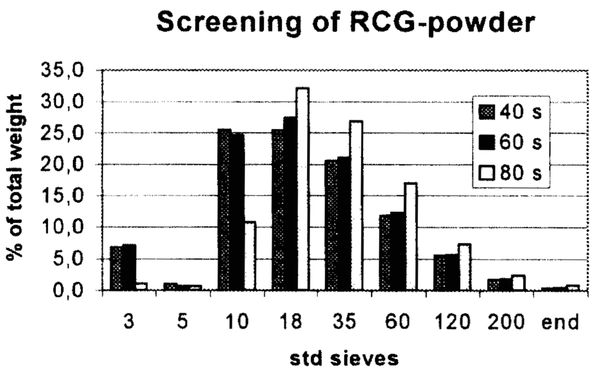

FIGURE 1. Results of the std sieve. 40 s, 60 s and 80 s mean the screening time.

The two peak problem in fractions is also encountered when different plant materials are processed with the same equipment and the aim is to produce equal homogenous filter material. E.g. long fibres from hemp and flax have curles and kinks. The two peak distribution in standard sieve could also be seen in FIGURE 1 when the short screening times were used.

COMPRESSIBILITY OF RCG-POWDER

RCG powder is used as a deep bed filter in filtration technology. Deep bed filtration is used when the concentration of the solids or the emulsified oil droplets is low. It is normally used as a post treatment to improve the water quality. In deep bed filtration the same basic idea is used as in the colaescing filtration. The oil-water mixture is led through a porous medium in which they have different penetrability rates. In the porous media water forms a water table (7).

The compressibility of a porous filter media is an important factor. That's why the compressibility of the RCG powder was measured with a membrane press (8). The jacket of the press chamber was filled with water.

By weighing the pressure tank the volume changes in the compression chamber could be calculated.

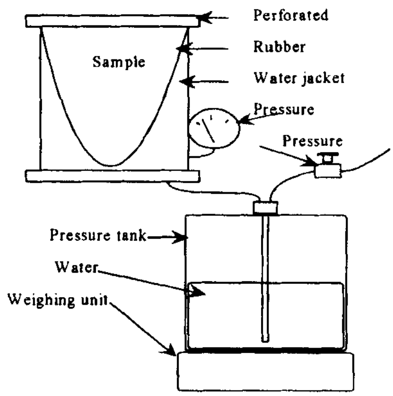

FIGURE 2. Membrane press for measuring the compressibility of RCG powder.

In deep bed filtration the filter media should be as firm as possible because the flux through the filter should be stable during the filtration process. A very compressable filter media means bad permeability for the filter. In FIGURE 3 the "powder"-fraction is more suitable for a deep bed filter media.

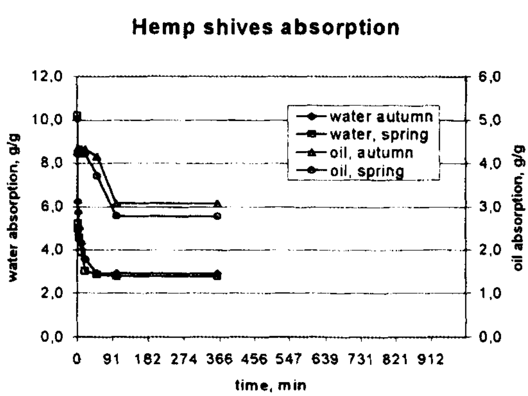

FIGURE 3. Compressibility of two different type RCG- fractions.

THE ASH CONTENT OF RCG-FRACTIONS

Reed Canary Grass collects silicates from the earth like other hays too. The silicate is collected as bio-opaline in the "bulliform" cells in leaves of the plant (9). The high silicate concentration is one hypothesis for the oil absorption of RCG material. The results concerning the standard sieve were collected in three groups. (TABLE 2). The samples were burned in a HERAEUS 170 furnace at 600 °C for 4 h.

TABLE 2. The groups of sieve fractions for ash content measurements.

Group	Sieves
Coarse	3 - 18
Medium	35 - 60
Fine	120 - end

The size of the pulverised silicate is very small. In the microscope the particles were smaller than 0,1 µm. The small size causes flocculation and colloid action between the particles and in the oil which reaches the deep bed filter (10). The results of the furnace burning are shown in FIGURE 4. The silicate concentration in RCG- ash is approximately 50 % (11).

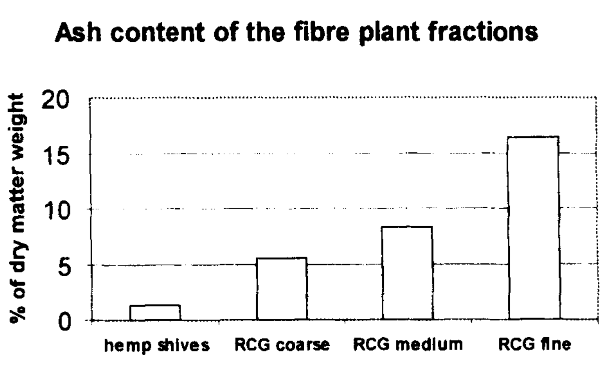

FIGURE 4. Ash content of different plant fractions.

3. Results

The deep bed filter was built in a 300 ml plastic funnell with a perforated bottom. A cotton pad was placed in both ends of the funnel to keep the powder inside the filter. The very simple test equipment is shown in FIGURE 5.

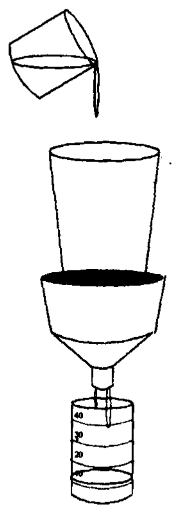

FIGURE 5. Test equipment for oil and water absorption.

A mixture of 200 ml ionized water and 80 ml 10W30 motor oil was poured through a 20 - 30 g sample. The amounts of oil and water were tested so that both oil and water were coming through the filter at the end of the test. So the result gives the maximum capasity of oil g/g sample.

The oil absorption was tested also as "allmix" where all the components: filter media, oil and water were mixed together. Also overpressure and spraying of oil and water through the filter media were tested. In FIGURE 6 the results are from the equipment shown in FIGURE 5.

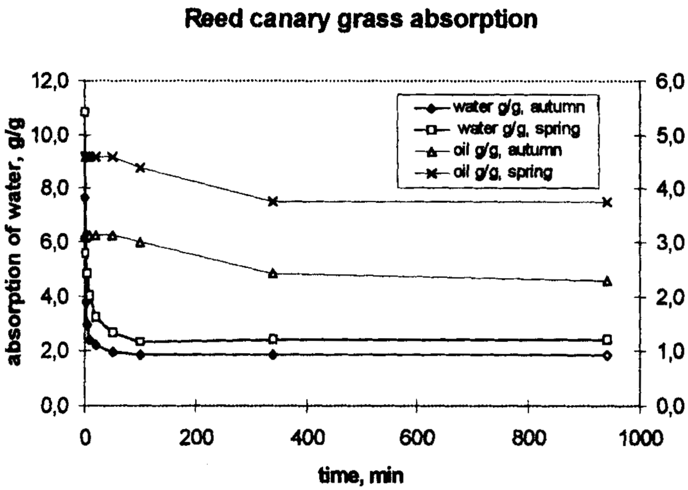

FIGURE 6. Water and oil absorption of autumn and dry-line - harvested RCG.

In figure 6 the tests were done with a powder from standard sieves 35 - end. Oil and water have higher absorption when spring harvested RCG was used as filter media.

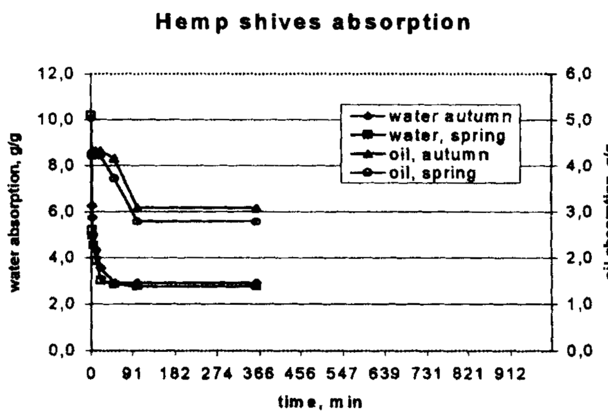

FIGURE 7. Water and oil absorption of autumn and dry-line - harvested hemp.

4. Discussion

The tests which were used in oil and water absorption measurements were not the best possible. There were problems in sample bulk density and with the channeling phenomena. However the sample materials have a typical bulk density which should be noted. When the filters are built the filter media should be glued so that no movement happens during the filtering process.

The two peak distribution of filter material is a problem because it causes compressibility and irregulrity inside the filter media. If the fibre and shive distribution is even in alla parts of filter it could also been used as a binder of the filter media.

In practise it is possible to produce e.g. covers round oil containing machine parts. So the oil leaks are first absorbed in these covers. Also a small filter could built in boats to filter the bilge waters. The price of this kind of product is not very high an it is also recyclable as fuel or by composting.

5. Conclusions

When RCG powder is used in oil absorption the spring harvested material absorbed more oil and water than autumn harvested. When hemp shives were used the result was opposite no difference was found in water absorption. The only reason for this could not be seen. However the high concentration of loose silicate in spring harvested RCG seems to have correlation on this

After the results RCG-powder can be used as a flow through filter for absorbing oil spills from water. When autmn harvested plants were used as filter media the color of the effluent was changed to yellow or green. However the change of color was not so clear when spring harvested materia was used. The effect of filter media to effluent should be paid attention on this research later on.

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