AGROTECHNOLOGY & FOOD INNOVATIONS
WAGENINGEN UR

Title Economic and technical aspects in the application of kenaf fibres

Work Package 5: Utilisation of kenaf for industrial products and energy.

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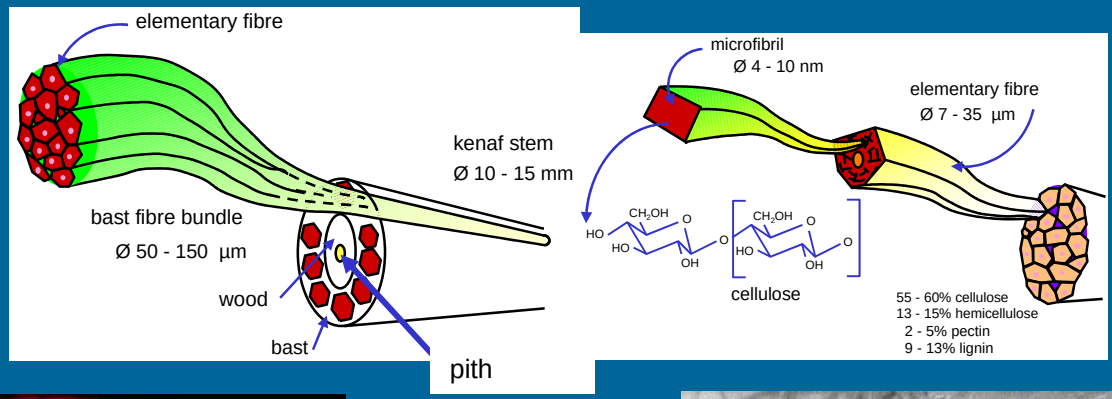
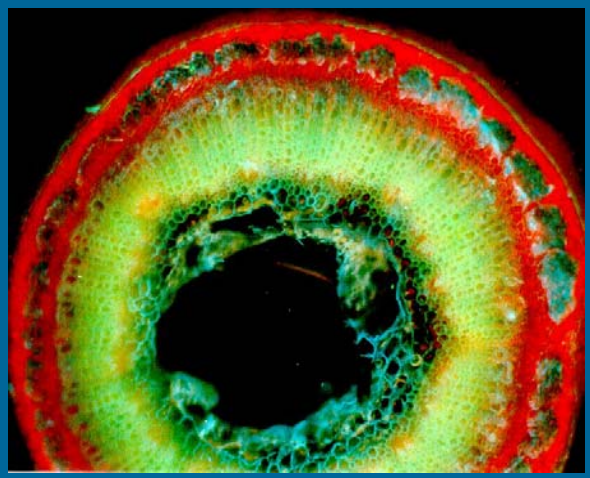
Work package 5

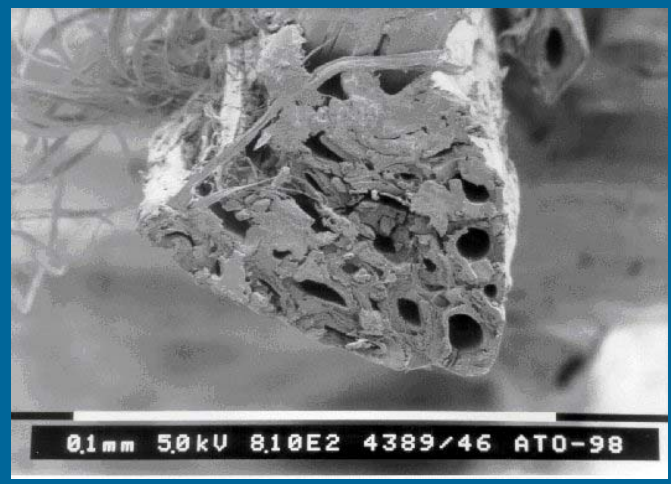
- **Task 5.1.1 Fractionating of kenaf stems (A&F)**
- **Task 5.1.2 Market and techno-economic feasibility studies for industrial application. Application tests on two or three selected areas (A&F)**
- Task 5.2 Thermal conversion experiments with combustion, pyrolysis and gasifier equipment (BTG and CRES)

Structure of kenaf stem





Flax stem



Kenaf fibre bundle

Applications study

- Composites
- Building materials
- Pulp and Paper
- Absorption particles

Kenaf in composites

- Already applied in woven and nonwoven mats combined with plastics.
- In woven applications- strength of fibre bundle is important.

Source hempflax

Kenaf in composites

- Natural fibres in compounds for injection moulding is in it's commercialisation stage.
- Strength of the elementary fibre is important not that of the fibre bundle.

Injection moulded products from natural- fibre/plastic granules

Kenaf in composites

- Compounding
  - weakened fibre bundles possible
  - the elementary fibres must be intact
- Extra compounding experiments
  - microbiological affected fibre bundles
  - is this degradation harmful to compound quality

Kenaf in building materials

- Particle boards
- MDF boards
- Hard boards
- Binderless insulation boards
- Insulation mats

Kenaf in particle boards

- Bast fibre is less suitable and to expensive for any type of board.
- Core fibre cannot fulfil the strength requirements and is not competitive with wood residues.

Kenaf in MDF boards

- Core fibre can be added to wood up to 10%, but has to be cheaper than wood.
- Whole stem can be added to wood up to 30%, but has to be cheaper than wood.
- Price of woodchips is around €70 /ton.

Kenaf in hardboards

- Whole stem gives a technically satisfying board.
- Not competitive with rest wood fraction and woodcuttings.

Kenaf in insulation materials

- Core in binderless thermal/sound insulation panels
  - Competition with wood.
  - Light weight and extra bonding by pith material can be advantage.
  - Extra experiments are needed.

- Bast fibres in insulation mats
  - Possible if technically comparable with flax fibres.
  - Competition with flax, hemp and jute (in spain €350/ton).
  - Experiments are needed.

Paper pulps

- Chemical pulp
  - lignin is removed in alkaline, sulphide or sulphite solutions
  - yield 45-55%
  - easy fibre separation
- Mechanical pulp
  - fibres are separated by mechanical forces
  - yield 85-95%
  - yellows under UV radiation
  - high energy costs

Kenaf in Paper and Board

- Technically possible but not competitive in most bulk papers.
  - Wood is cheaper

- U.S.A.– Whole kenaf for newsprint had good prospects – a mill was never build
  - high investment costs and the need for reliable supplies of kenaf result in high risks.
  - 400.000 tons/y —> 480 million € = €1200/ton/y

Kenaf in Paper and Board

- Can be used in specialty papers
  - bible, cigarette and security papers
  - small scale
  - competition with flax, hemp and jute
  - price of jute in Spain around € 350,- /ton

- U.S.A.–Vision Paper
  - chlorine free
  - tree free

Kenaf in Paper and Board

- Compared to wood, whole stem kenaf in APMP pulping for newsprint can bring substantial savings in electrical power needs.
- An experiment can determine if this saving is in the same order of magnitude as with jute.

Kenaf core absorption particles

- Cleaned core is suitable in animal bedding –€ 225 /ton.
- At € 200/ton kenaf core absorbs per unit of costs three times as much oil as polypropylene does.
- High price, profits depends on distribution distance.

Stable bedding from hemp core

source hempflax

Kenaf core absorption particles

- Applied methods are often very different
- Competition with hemp and flax cores
- Pith is strongest absorbent, higher amount in kenaf
- Comparison between kenaf, hemp and flax is necessary

Small-scale separation of kenaf

- A small- scale mill has better chances.
- Application of bast and core in different applications.
- Smaller investment costs.
- Easier start and expansion (hempflax 2300 ha).

A&F Research Focus and priority list

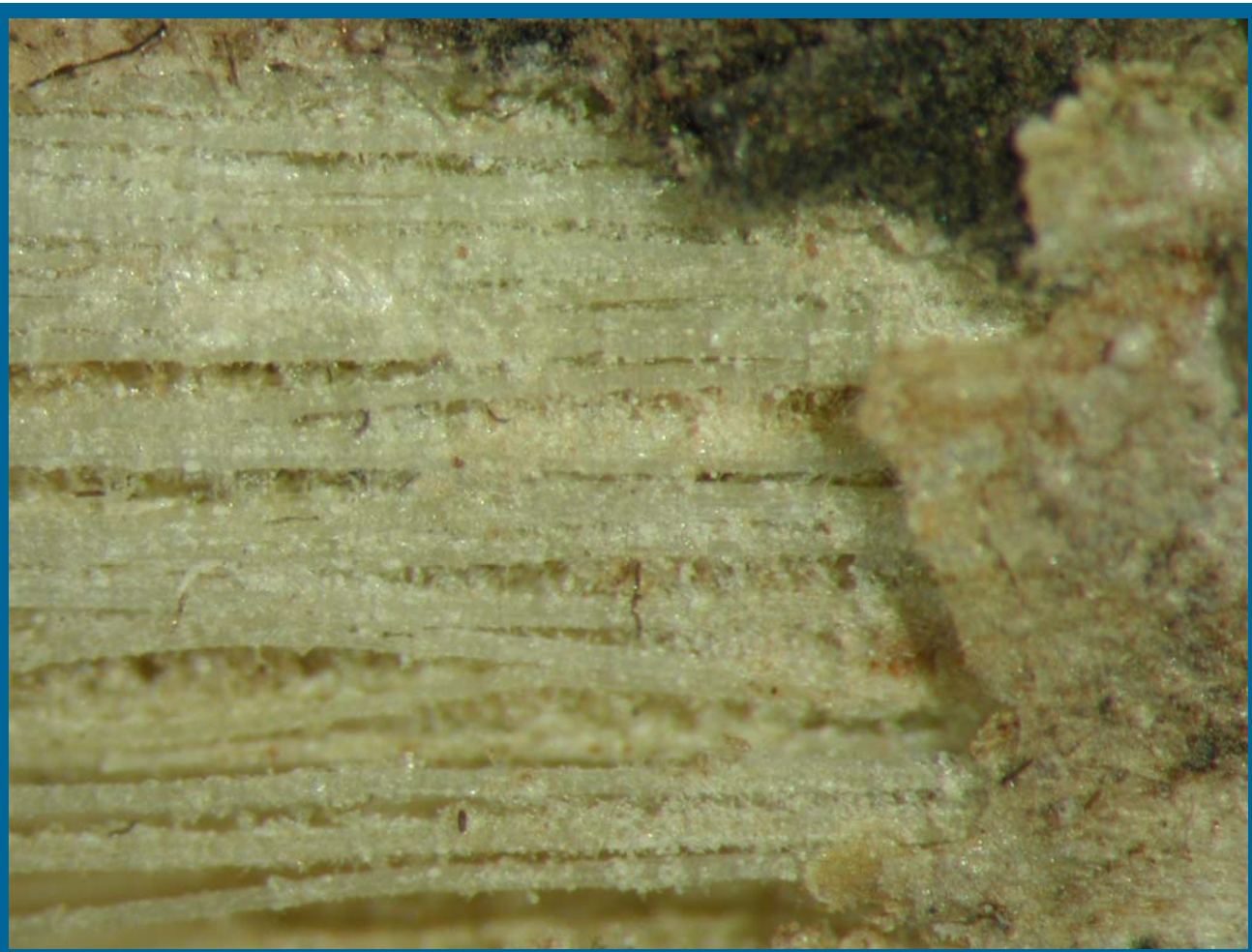
- **Insulation mats of bast fibres.**
- **Comparison of kenaf core with hemp and flax core in stable bedding and oil spill absorber.**
- If time and budget allows
  - Compounding of microbiological partly degraded kenaf bast fibre.
  - APMP comparable to already done jute experiment
  - Binderless insulation boards of core fibres

Affected kenaf stems

Unaffected FAIR project

Affected BIOKENAF project

Disappeared epidermis



Fibre bundle strength

		Tensile strength
		MPa
BIOKENAF		
harvest December 2003		347
harvest Februari 2004		382
FAIR		
retted		556 to 682
green decorticated		276-435

Fibre extraction - kenaf stem parts

Fibre extraction - breaking

Fibre extraction- bast fraction

Fibre extraction -scutching

Fibre extraction -scutched fibres

First sowing	Fraction of total [%]	Bast Content [%]	Long fibres after scutching
Base	53.7	27.6	
Middle	32.3	33.5	
Top	14	33.3	
Mixture	(53.7 B+32.3M+14T)	33.3	10.2
FAIR			21.6

Fibre extraction -scutched fibres

Further work

- Separation on industrial scale
- small trial with 50 kg baled kenaf
- large trial with 3000 kg baled kenaf
- Forming insulation mats with bast fibres
- absorption experiments with core