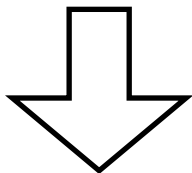




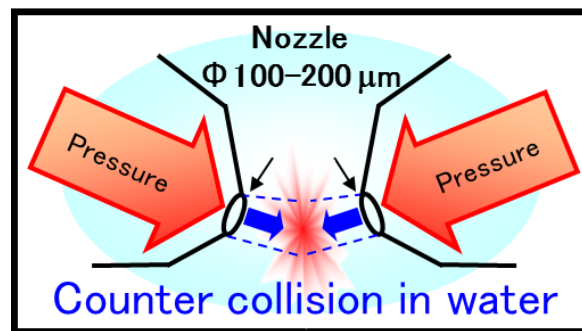
# << Development of new system for waste paper >>

Waste paper

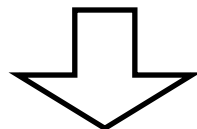


Aqueous counter collision method (= ACC)

Cellulose nanofiber



Miniaturization by rapid water stream

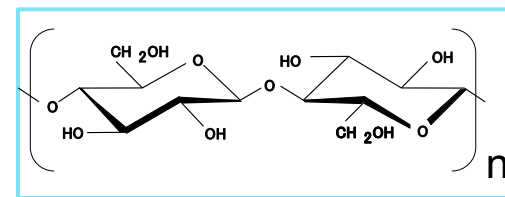


Ordered structure at micro-scale



Nanofiber-aligned material

Cellulose molecule



Nanofiber = molecule-aligned material

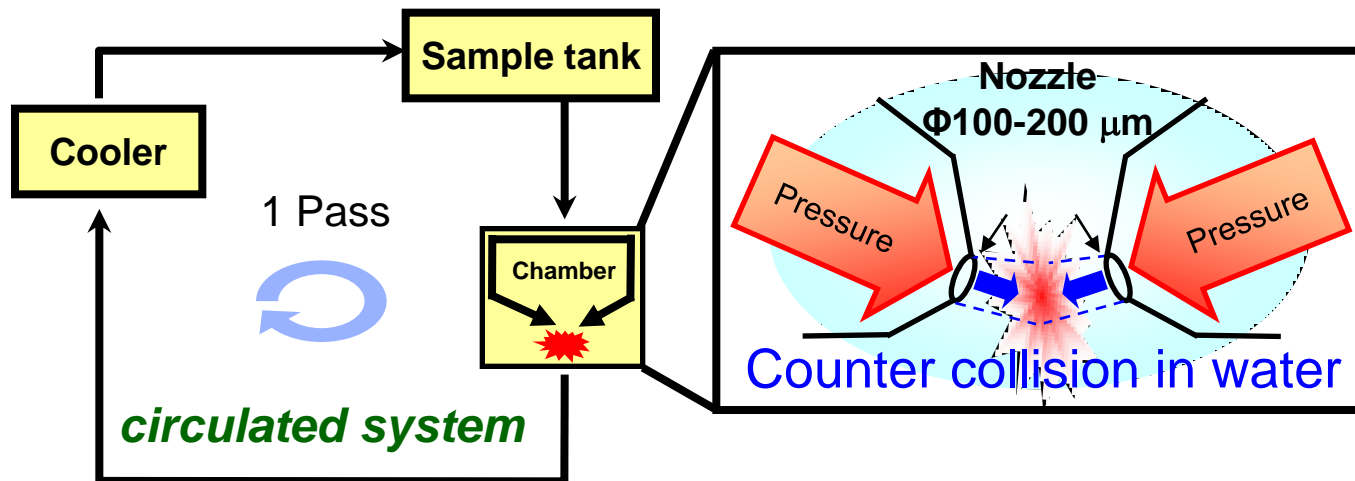
< Recycle >  
Separation and Refinement of impurity by ACC

Agent strengthening paper

Water-resistant material  
High-intensity material

New form of waste paper

# Aqueous Counter Collision system (= ACC)<sup>1)</sup>



## Each bonding energy

Type of bond	Bonding energy / kJ mol <sup>-1</sup>
H-OH (covalent bond)	499 <sup>2)</sup>
H-H (covalent bond)	436 <sup>2)</sup>
ion-ion	250 <sup>3)</sup>
Medium hydrogen bond	21 – 62 <sup>4)</sup>
Weak hydrogen bond	4.2 × 10 <sup>-1</sup> - 4.2 <sup>4)</sup>
London dispersion force	2 <sup>3)</sup>
dipole-dipole	0.6-2 <sup>3)</sup>

## Properties of ACC

- **Cleavage of only intermolecular interactions** without chemically modifying molecules
- Liberating nano-fibers from raw materials
- A rapid process to provide nano-fibers
- Chemicals-free ( using water alone )

Maximum bonding energy cleaved by ACC (Theoretical value)

**18.1 kJ/mol<sup>-1</sup>**

1. Kondo T., Morita M., Hayakawa K., Onda Y., U.S. Patent 7,357,339.
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3. P. W. Atkins, In "Physical chemistry sixth edition", p716, Tokyo kagaku dojin Ltd., Japan (2001)

4. H. Uedaira, In "Molecular engineering of water", p7, Kodansha Scientific Ltd., Japan (1998)

# Important natural phenomena in new recycle system for waste paper

