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Fibre suspension flow modelling - a new COST action in 2011- 2015

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Outline



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- Presentation
 - ERCOFTAC SIG43 and COST Action
 - State-of-the-art fibre suspension modelling and experiments
 - Scientific program of the COST Action
 - Management of the COST Action – candidates
- Today's COST Action preliminary meeting
 - Preparations for Management Committee (MC) meeting on May 11
 - Open to all of us, but especially (MC) members and persons who would like to join the COST Action are asked to attend

COST (www.cost.eu)

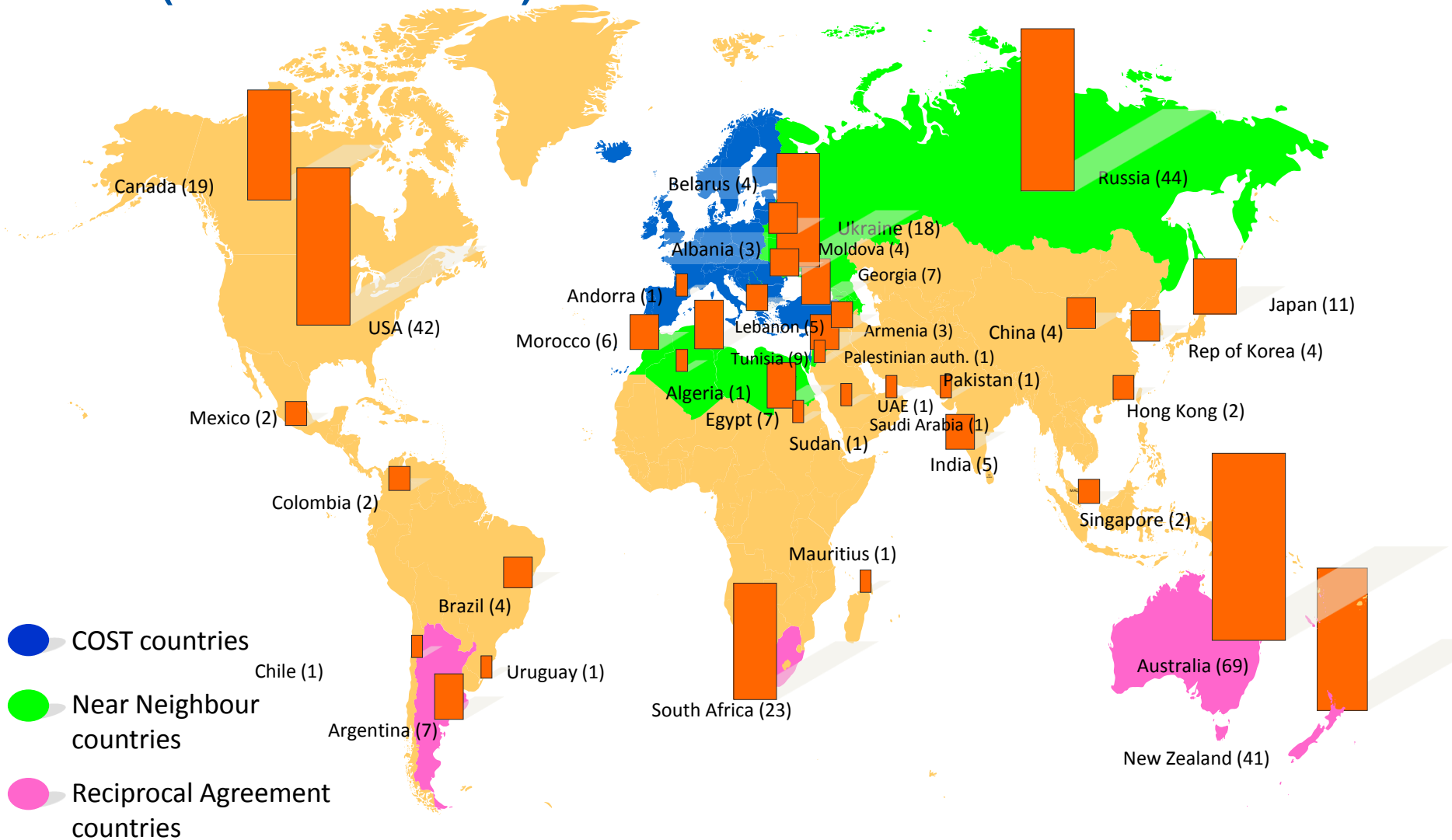


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- COST is an intergovernmental framework for European **Cooperation in Science and Technology**, allowing ***the coordination of nationally-funded research*** on a European level.
- Strengthen Europe in scientific and technological research for peaceful purposes through the support of cooperation and interaction between European researchers.
- Ease of access for institutions from ***non-member countries*** also makes COST a very interesting and successful tool for tackling topics of a truly global nature.
- This research initiative makes it possible for the various national facilities, ***institutes, universities and private industry*** to work jointly on a wide range of Research and Development (R&D) activities.
- COST contributes to ***reducing the fragmentation*** in European research investments and opening the European Research Area to cooperation worldwide.

COST Actions: global participation

(status: June 2010)



History of our COST Action



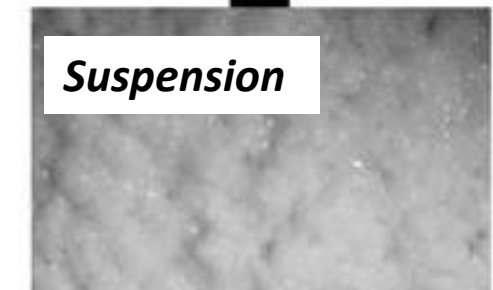
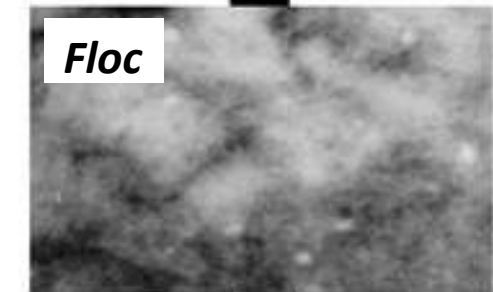
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- ERCOFTAC SIG43
 - Decision to establish ERCOFTAC Special Interest Group (SIG43) on fibre suspension flows made in 2007 (conference dinner, ICMF, Leipzig)
 - SIG43 established in 2008, kick off-meeting in November in Brussels
 - Workshops in Finland (2009), Sweden (2010) and now in Italy (2011)
- COST
 - Preliminary COST proposal done by Prof. Dariusz Asendrych in 2009
 - The 1st full proposal in Jan 2010, the 2nd one in July 2010 (accepted)
 - **Fibre Suspension Flow Modelling** (FP1005) belonging to the Scientific Domain **Forests, their Products and Services**
 - The kick off –meeting will be in Brussels on May 11, 2011
 - Austria, Finland, France, Germany, Italy, Netherlands, Poland, Portugal, Spain, United Kingdom // Norway, Slovenia, Sweden // Canada, USA // Switzerland, Brazil,... **Door is still open!**
 - The budget/year depends on the number of the countries:
 - 12 countries -> 53 000 €, 17 countries ->69 000 €, 20 -> 78 000 €



Scientific Program - Background

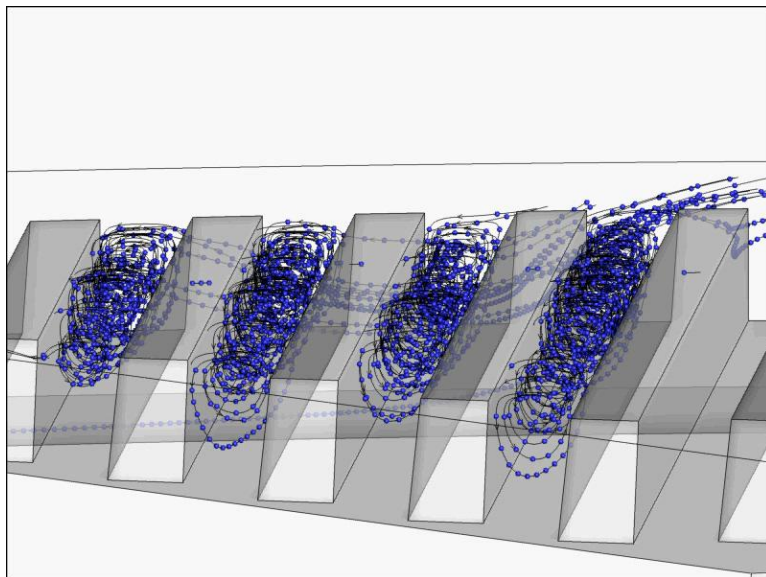
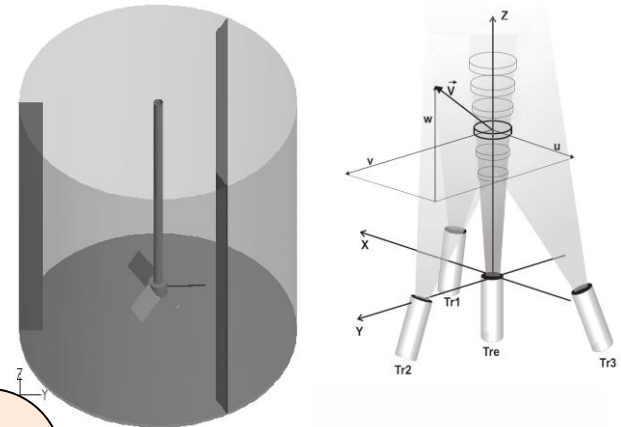
- One litre of fibre suspension at 1 % concentration contains 10 million fibres
 - Fibre-level simulations (i.e. Lagrangian approach) possible for $\sim 10,000$ fibres
 - Either very small volume (1 cm^3) or very dilute suspension
- Engineering applications ($1 \text{ m}^3 = 10^6 \text{ cm}^3$) require more practical modelling approach - Eulerian
 - From fibre-level to floc-level modelling and experiments
 - Eulerian models for fibre orientation and flocculation
- High-concentration applications
 - Non-Newtonian rheology for the mixture



Current state of knowledge

- One-phase approach

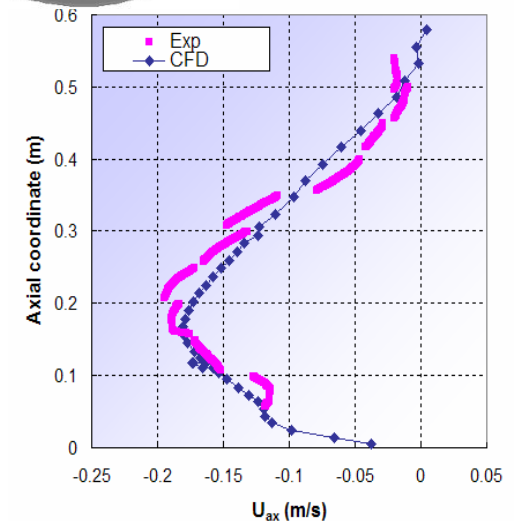
- Pulsed Ultrasound-Doppler Velocimetry (PUDV)
- Non-Newtonian viscosity models



RHEOLOGY

Loss correlation
 $\Delta P = \Delta P(Q, R, \rho, \mu)$

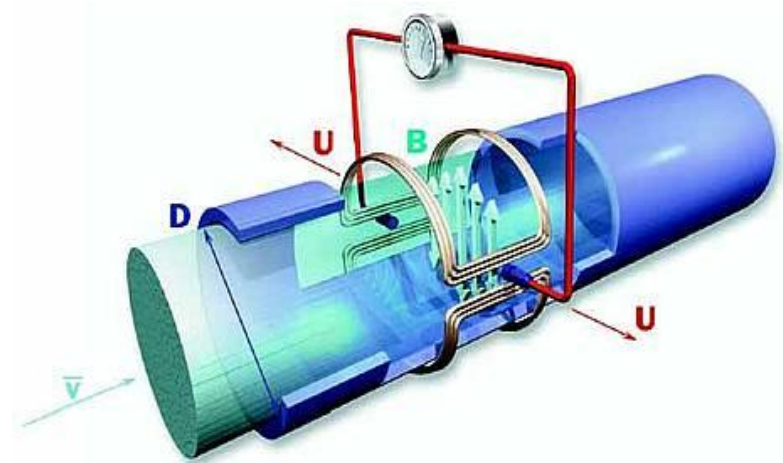
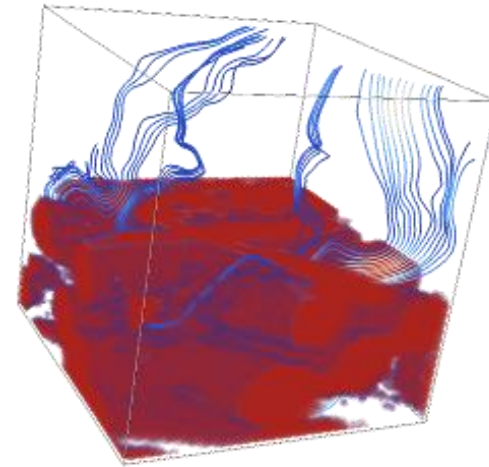
Apparent viscosity
 $\mu = \mu(\dot{\gamma})$



Current state of knowledge

- Two-phase approach

- Optical Coherence Tomography
- Electrical Impedance Tomography
- X-ray Computed Tomography
- Lattice-Boltzmann simulations



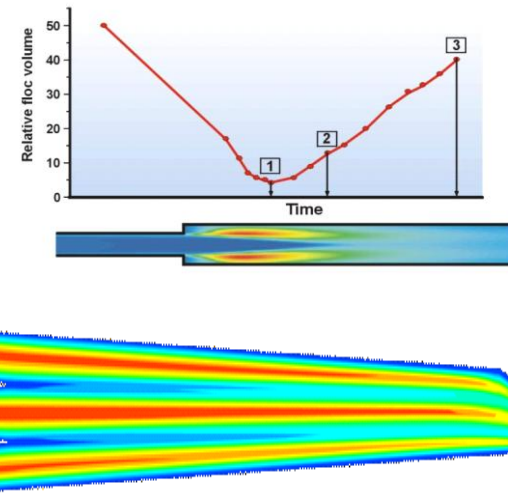
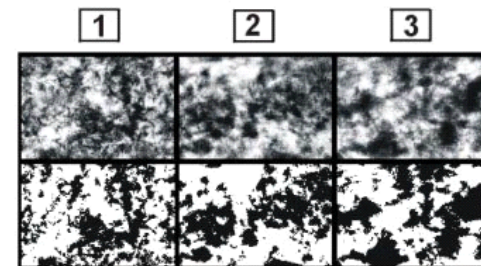
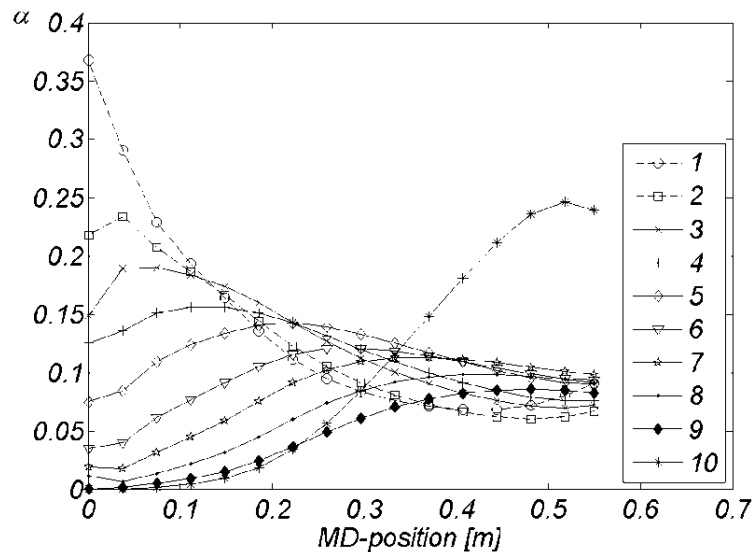
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Current state of knowledge

- Two-phase approach



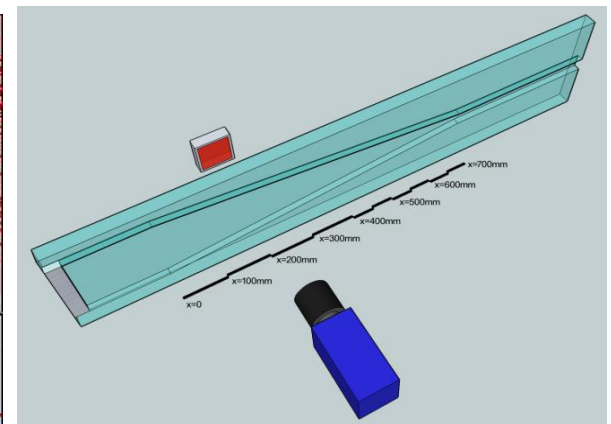
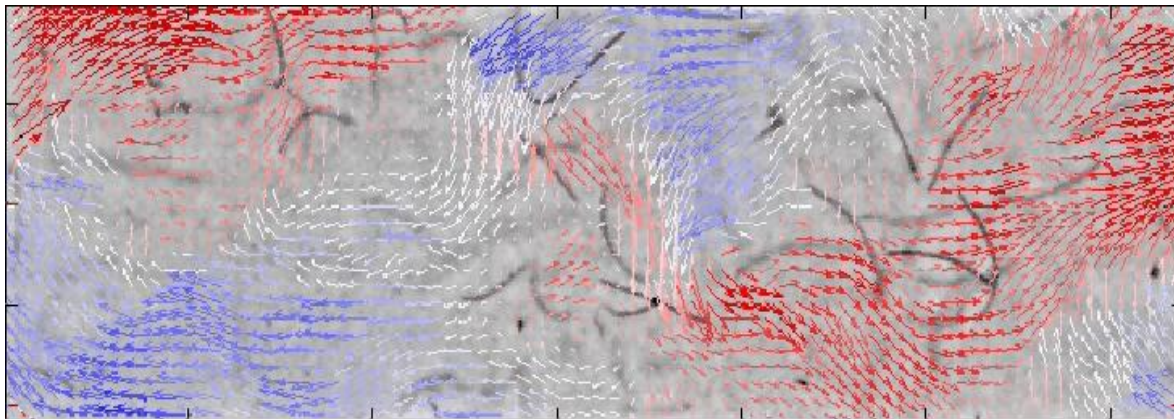
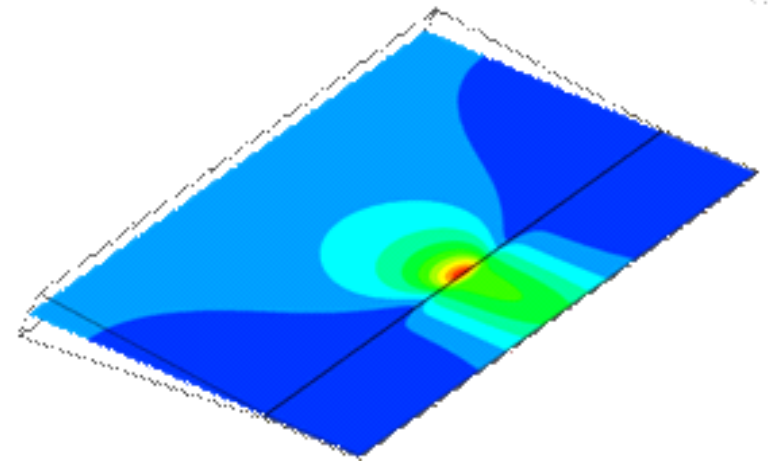
- CCD camera technique for fibre floc break up and coalescence
- Fibre floc evolution (FFE) model



Current state of knowledge

- Fibre-level approach

- Particle Image Velocimetry (PIV)
 - Movement and deformation of fibres as well as flow turbulence simultaneously
- Fibre orientation probability distribution (FOPD) model



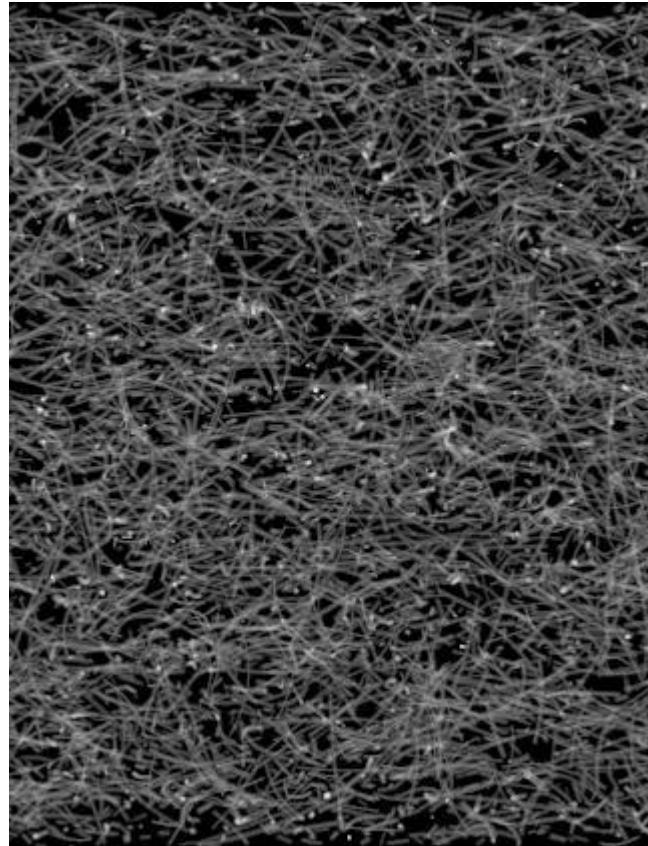
Current state of knowledge

- Lagrangian fibre flow simulations

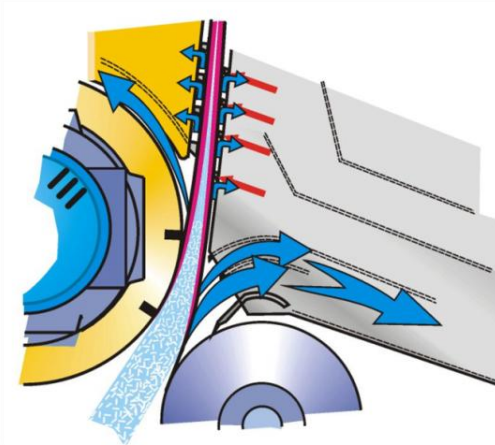
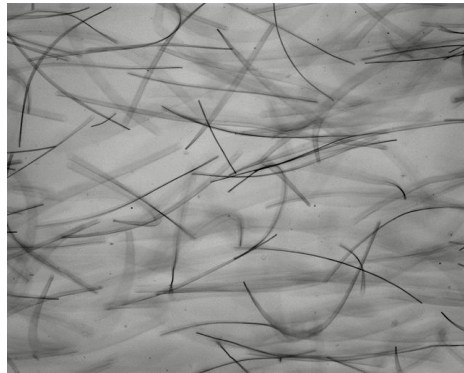


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Inlet



Outlet



Scientific Programme

Selected Focus Areas



- **Area 1: Experimental techniques for fibre suspension flows**
 - Material parameters to models
 - Correlations between fibre and suspension properties
 - Development of new experimental methodologies
- **Area 2: Predicting pulp behaviour with single-phase models**
 - Generalized-Newtonian and fully non-Newtonian rheology models
 - Turbulence dampening due to high fibre concentration
 - Applications in stock preparation and high-concentration forming
- **Area 3: Modelling fibre suspension flows with multi-phase models**
 - Detailed fibre-level Lagrangian simulations in cm^3 -scale
 - Eulerian multi-phase flow model development in industrial scale
 - Applications in headbox and forming section - improved paper quality

Objectives of the Action



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- **Objective 1:** First, **Awareness** and secondly, **coordination** of research activities on modelling and experiments of fibre suspension flows carried out in different countries and organizations
- **Objective 2:** To **demonstrate** modelling and experimental techniques in industrially relevant fibre suspension flow problems
- **Objective 3:** To **promote** and **disseminate validated** computer modelling and simulation techniques in papermaking industry
- **Secondary objectives:** Establishment of a **knowledge base** for both simulated and measured data of the test problems defined in the Action; also a book, survey of the state of CFD in industry, training periods, launching of joint projects, exchange of experience

How to achieve the objectives?

Coordination, Demonstration and Validation



- Concerted efforts in **demonstration** based on selected test problems offered by industry - *Industrial test case solving contest*
 - Specified geometries, flow conditions, fibre types, etc. and outputs
 - Users of different experimental methods will compare their methods in selected flow problems
 - Similarly, users of various modelling approaches will solve test cases
- **Validation** of modelling and simulation based on the test problems
 - The same test cases are modelled and measured
 - Close collaboration of modellers and experimentalists
 - Note that concrete research work is done in national research projects
- **Coordination** is done by the COST Action committees and WGs
 - From the test cases to long-term European research coordination

How to achieve the objectives? Awareness and Dissemination



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- **Awareness:** industrial challenges to academia, scientific possibilities to industry, as well as "horizontally" between organizations
 - Survey of the state of use of numerical methodologies in industry
 - Selection of the industrial test cases for solving contests
 - Joint meetings, workshops and conferences
 - Training schools and research exchange
- **Dissemination:** book(s), reports and web-pages
 - Workshop proceedings of the industrial test case solving contests
 - Best practical guidelines on fibre suspension flows - experiments and modelling

How to achieve the objectives?

Knowledge base – the Action arena



- Knowledge base will be established and maintained for the test problems defined jointly by the Action members including:
 - Descriptions of the industrial test problems
 - Both modelled and measured solutions of the test problems by using various methods done by different Action members
 - Validation reports presented in workshops or meetings organized during the Action
 - Material will be reviewed and accepted by MC
- Knowledge Base will be maintained after the Action
 - ERCOFTAC Special Interest Group on Fibre suspension flows (SIG43) (or another responsible group)
 - Responsibilities will be decided in the beginning of the Action

Emphasis on Early Stage Researchers (ESR)



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- ESR think tank
 - Group of enthusiastic young researchers which performs research and develops reports and recommendations on topics relating to fibre suspension flows - experiments and modelling
 - Note: About 25 % of the experts of the Action are ESR, half of them are from industry or SMEs, half from universities
 - ESR = doctoral degree no more than 8 years ago (2003,...)
- Short-Term Scientific Missions (STSM)
 - Short visits to research organizations, participating in on-going projects, solving a problem, and writing scientific papers
 - At least 10 % of the Action budget will be used to STSM

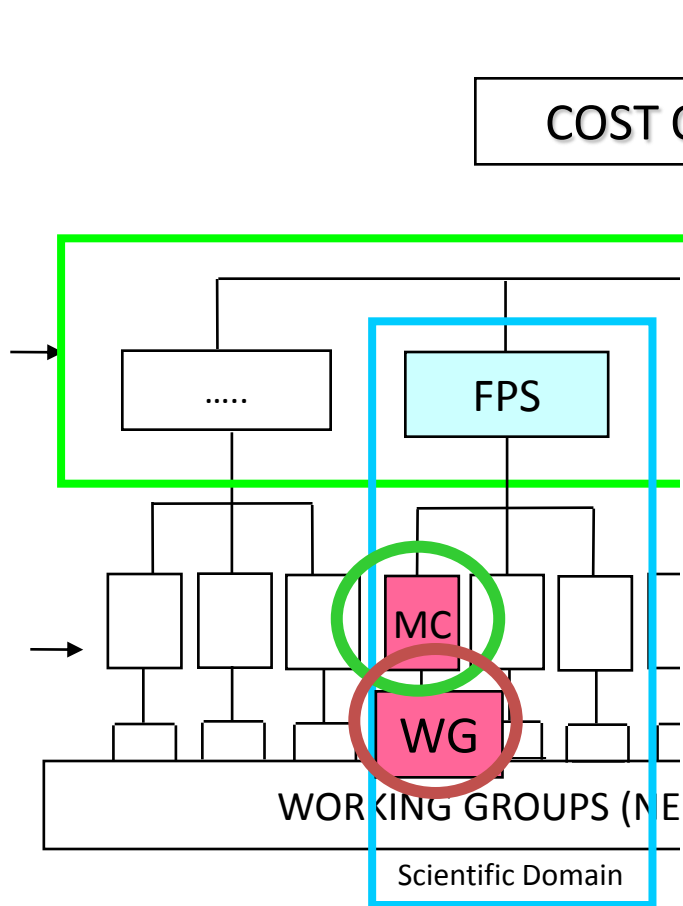


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COST Action preliminary meeting



Management Committee and Working Groups



Working groups

- a small number of researchers working together
- MC members or other scientists from the Parties
- invited experts / speakers (workshops / conferences)
- members from non-COST country institutions

AGENDA (Kick-off meeting, May 11)



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- Election of Chair and Vice-Chair of the Action
- Appointment of
 - A Grant Holder and its representative as the Action's budget administrator (agreement of overhead rate)
 - Two financial Rapporteurs
- Working plan for the implementation of the COST Action (Memorandum of Understanding)
 - objectives and working programme
 - organisation and management (including Working Groups, Core Group)
 - distribution of tasks and election of WG leaders and STSM Coordinator/Committee
 - Action website
 - Promotion of Gender Balance and of Early Stage Researchers
 - Time-table for the Action, Activity plan and budget for first budget year
- Budget Plan for the first period

Election of Chair and Vice Chair

The Action must elect a:

- Chair, and a
- Vice Chair

The MC shall appoint from among its members representing **Parties or European bodies**, by a simple majority vote, a Chair and a Vice-Chair for the duration of the Action (Rules and Procedures for Implementing COST Actions (*COST 4159/10*) *Annex II: “Rules of procedure for Management Committee” Article 7*).

Appointment of Grant Holder and FRs

The Action must :

- appoint a Grant Holder institution,**
- agree the Grant Holder overhead rate (maximum 15% of scientific expenditure), and**
- appoint 2 Financial Rapporteurs (not from institution of Chair, Vice Chair or Grant Holder)**

Grant Holder:

- Must be the institution of a MC Member**
- Legal, Financial and Scientific representative**

Financial Rapporteurs:

- Review the annual and final financial reports prepared by the Grant Holder inform the COST office that they accept these reports or draw issues to the attention of the COST Office**

Aspects to consider

Does MC need a Core Group/ Steering Committee?

Working Group Coordinators

Composition of Core Group/ Steering Committee

(usually Chair, Vice-Chair, WG Coordinators, STSM Coordinator)

STSM Coordinator and/ or Committee?

Target for number of STSMs per year (> 4)?

Action Website

Activity plan/ Budget Year

When and where to hold next meetings (must be scientifically/ economically justified – not just “a nice place”)

Candidates



- MC
 - Chairman: Fredrik Lundell, Sweden (Ph.D. in 2003)
 - Vice-chairman: Jari Hämäläinen, Finland (link to ERCOFTAC)

 - Or, Chairman Janne Poranen, VTT, Finland
 - Vice-chairman from Sweden
- WG leaders:
 - Rheology: Maria Rasteiro, Portugal
 - Experiments: Tero “Maria” Pärssinen, Finland (Ph.D. in 2007, industrial representative)
 - Multi-phase flow modelling: Cristian Marchioli, Italy (Ph.D. In 2003)
- Budget administrator is typically from chairman’s organization

Concrete actions in 2011-2012



- Administrative actions
 - MC meeting
 - Steering Committee meeting and all the WG meetings
 - Can be arranged jointly with scientific meetings
- Scientific actions
 - Selection of the first group of the test problems
 - Planning of Best Practice Guidelines
 - Establishment of Knowledge Base
 - Launching of the Action website
 - STSMs
 - Workshop(s)

Example CGS budget plans

STSMs¹	8 574	10 365	20 000
Meetings	30 600	43 200	47 000
• <i>Meeting travel costs²</i>	<i>29 600</i>	<i>42 000</i>	<i>45 600</i>
• <i>Workshop support³</i>	<i>1000</i>	<i>1200</i>	<i>1 400</i>
Training School⁴	13 000	16 000	19500
Dissemination			500
Scientific Expenditure	52 174	69 565	87 000
Grant Holder⁵	7 826	10 435	13 000
Budget	60 000	80 000	100 000

- 1 @ least 4 per year as per COST Strategy ESRs
- 2 Average reimbursement = 800 €/ person (=> 29600 ~ 37 reimbs, 42000 ~ 52 reimbs, 47000 ~ 59 reimbs)
- 3 Organisation Support Grant (meetings and Training Schools) = 30 €/ participant
- 4 Trainees $n1 \times \# \text{€ grant} + \text{Trainers } n2 * 800 \text{ € avg reimbursement} + \text{Organisation Support Grant @ } (n1+n2) * 30 \text{ €} = \text{Training School budget}$
- 5 Under COST Grant System –Grant Holder payment “FSAC” (max 15% of scientific expenditure)

Non-COST countries

Financing of non COST country participants from:

Reciprocal Agreement (RA) Countries

- *Financing from COST (special budget) for COST Action members to visit participant in RA country (Reciprocal STSM “RSTSM”)*
- *Financing from national implementing agent for COST Action participant in RA country to attend COST meetings*

Near Neighbour (NN) countries

- *One representative per NN institution per meeting per year (max. 2 per NN country at MC meeting) from special budget*
- *STSMs from/ to NN country institution (special budget)*

Rest of World

- *Must finance their own participation in Action meetings (mutual benefit)*
- *Action budget can pay for STSM from COST country to participating institution in “rest of world” country (not in the other direction)*

COST Acronyms

- **CSO** **Committee of Senior Officials**
- **JAF**
CSO) **Juridique, Administration, Financier (executive group of**
- **DC FPS** **Domain Committee Forests, their Products and Services**
- **MC** **Management Committee**
- **WG** **Working Group**
- **SO** **Science officer**
- **AO** **Administrative officer**
- **STSM** **Short Term Scientific Mission**
- **ESR** **Early Stage Researcher (< PhD + 8 years)**
- **CGESR** **Conference Grant Early Stage Researchers**
- **PAYG** **Pay As You Go (the current COST financing mechanism)**
- **CGS**
mechanism) **COST Grant System (the future COST financing**



www.cost.eu