Experiment Report Form

The double page inside this form is to be filled in by all users or groups of users who have had access to beam time for measurements at the ESRF.

Once completed, the report should be submitted electronically to the User Office using the **Electronic Report Submission Application:**

http://193.49.43.2:8080/smis/servlet/UserUtils?start

Reports supporting requests for additional beam time

Reports can now be submitted independently of new proposals – it is necessary simply to indicate the number of the report(s) supporting a new proposal on the proposal form.

The Review Committees reserve the right to reject new proposals from groups who have not reported on the use of beam time allocated previously.

Reports on experiments relating to long term projects

Proposers awarded beam time for a long term project are required to submit an interim report at the end of each year, irrespective of the number of shifts of beam time they have used.

Published papers

All users must give proper credit to ESRF staff members and proper mention to ESRF facilities which were essential for the results described in any ensuing publication. Further, they are obliged to send to the Joint ESRF/ ILL library the complete reference and the abstract of all papers appearing in print, and resulting from the use of the ESRF.

Should you wish to make more general comments on the experiment, please note them on the User Evaluation Form, and send both the Report and the Evaluation Form to the User Office.

Deadlines for submission of Experimental Reports

- 1st March for experiments carried out up until June of the previous year;
- 1st September for experiments carried out up until January of the same year.

Instructions for preparing your Report

- fill in a separate form for each project or series of measurements.
- type your report, in English.
- include the reference number of the proposal to which the report refers.
- make sure that the text, tables and figures fit into the space available.
- if your work is published or is in press, you may prefer to paste in the abstract, and add full reference details. If the abstract is in a language other than English, please include an English translation.

<table>
<tr><td>ESRF</td><td>Experiment title:
Orientation under Process Engineering Conditions</td><td>Experiment number:
MA-160</td></tr>
<tr><td>Beam line:</td><td>Date of experiment:
from: 28 September 2007 to: 03 October 2006</td><td rowspan="2">Date of report:
10 Feb 2008

Received at ESRF:</td></tr>
<tr><td>Shifts:
12</td><td>Local contact(s):
Jonathan Wright</td></tr>
<tr><td colspan="3">Names and affiliations of applicants (* indicates experimentalists):
Adrian R. Rennie, Department of Physics, Uppsala University, Sweden.
Jeremy Karl Cockcroft, Dept. of Chemistry, University College London, UK.
Jonathan Targett, Dept. of Chemistry, University College London, UK.
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Aims

This experiment was planned to explore the application of high energy, angle dispersive diffraction as tool to investigate complex flows under process conditions. This continued previous studies using energy dispersive diffraction [1,2] and continued work on liquids that contained dispersed kaolinite particles.

Experimental

The experiment was performed on ID11 with X-ray energy of 50 keV. Diffraction patterns are collected on the Bruker CCD detector. A beam size of 50 × 50 μm on the sample was obtained with refractive lenses. Kaolinite with 8% by weight was stabilized with 0.5%wt sodium polyacrylate. This dispersion of stabilized kaolinite particles was pumped through a cylindrical, aluminium pipe of internal diameter 5mm. The pipes were either uniform or contained nozzles of different diameter. This is shown schematically in Figure 1.

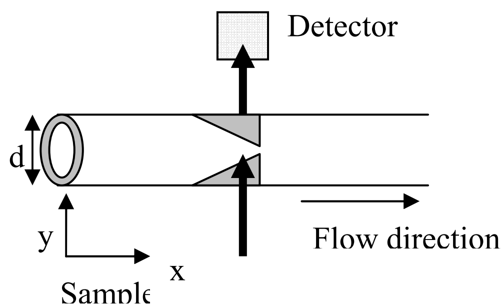

Figure 1. Schematic diagram of apparatus mounted on x-y translation table and arranged to collect low angle diffraction

Results

The aluminium pipe as well as the kaolinite dispersion gave rise to diffraction. Although of practical interest, the multiple scattering from individual grains in the aluminium meant that a

statistical procedure, identifying single peaks had to be adopted to select pixels for analysis of the kaolinite diffraction. Typical data is shown in Figure 2.

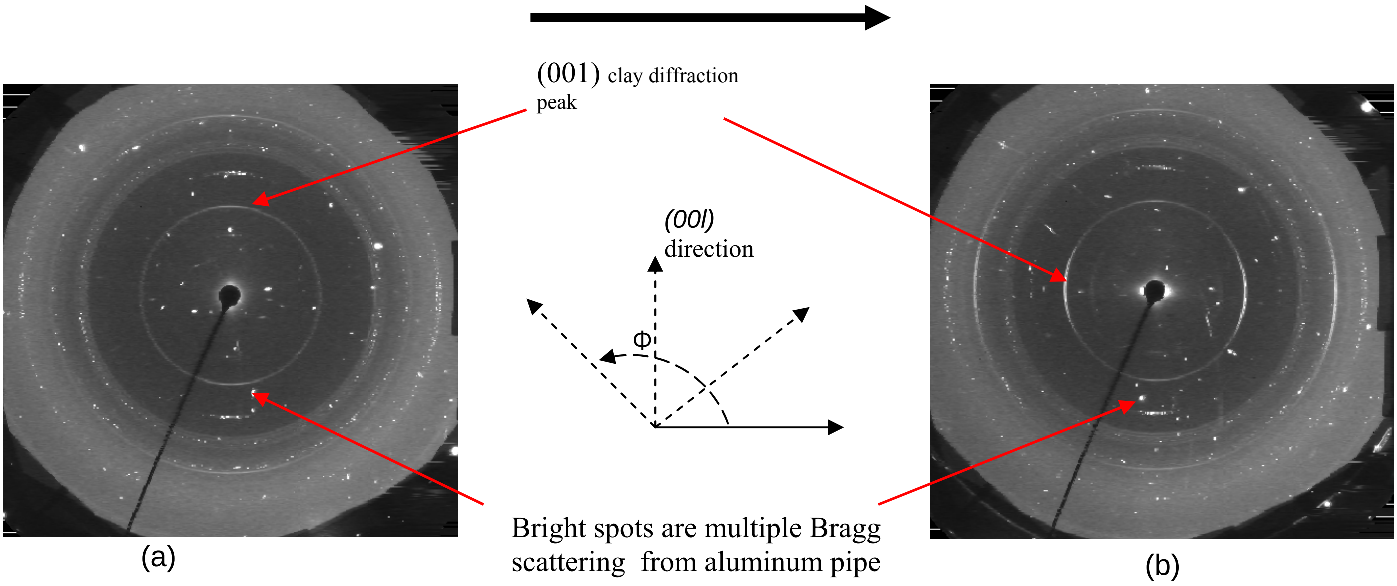

Figure 2. Raw data diffraction patterns from the sample while flowing through the aluminum pipe. a) is at x = 0.5, y = 0.0 and b) is at x = 0.0, y = 0.0 i.e. nozzle opening.

Analysis of the data has consisted of evaluating peak intensities as a function of azimuthal angle and then plotting intensities and positions of peaks in the scattering as a function of the location of the pipe in the X-ray beam. This is shown in Figure 3.

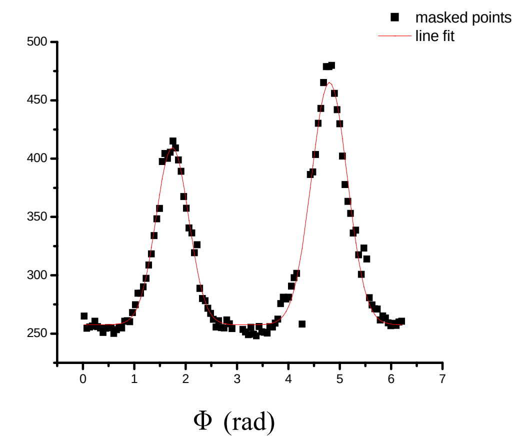

Fig. 3 (a) Diffraction intensity for the (001) peak is fitted as a function of azimuthal angle φ with two Gaussians. Solid squares are the actual data points after masking, continuous line is a fit to data.

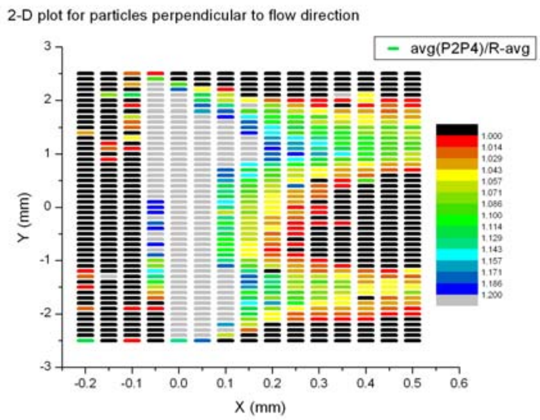

Figure 3 (b) Map of the ratio of 001 peak intensity (+/- 10 degs) about direction perpendicular to pipe Both plots are for 2 mm diameter nozzle and a flow rate of 5 cm^3s^{-1}

Discussion and Conclusions

There is marked disalignment in very close proximity to the nozzle opening. Some unexpected alignment perpendicular to the flow was observed and this needs to be investigated further. Asymmetry in the peaks is similar to that observed by Meheust et al [3] in a different system.

References

[1] Barnes P., Jupe A. C., Jacques S. D. M., Colston S. L., Cockcroft J. K., Betson M., Hall C., Barè S., Rennie A. R., Shannahan J., Carter M. A., Hoff W. D., Wilson M. A., Phillipson M. C. Nondestructive Testing and Evaluation 17, 143-167 (2001)

[2] Rennie, A. R., Barè S., Cockcroft J. K., Jupe A. C. J. Colloid Interface Science **293**, 475-482 (2006).

[3] Meheust, Y. Knudsen K.D. Fossum J.O., J. Appl. Cryst. **39**, 661,670 (2006).