TEST CASE 1: DENSE FLUIDISED BED

Summary

This case concerns fluidised box with fine and coarse particle. The box section is 0.20m width and 0.29m breath. At rest, the static bed height is 0.43m. Two superficial gas velocities are explored. The operating conditions correspond to ambient conditions.

Calculation Request

- Bed height,
- Local time pressure series,
- Dynamic bubble:
  . Diameter
  . Velocity
  . Frequency
  . Dynamic record of solid volumetric fraction map

Information

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Experimental Setup

Geometry of fluidised bed (see Fig 1).
Width: 0.20 m
Breath: 0.29 m

Distributor plate.
Bronze porous plate (grade C).
Thickness: 3.0 mm.
Minimum particule retention: 15-20 µm
ΔP characteristics: see Fig 2.

Pressure drop tappings location.
0.15, 0.25 and 0.35 m above distributor plate (see Fig 1).

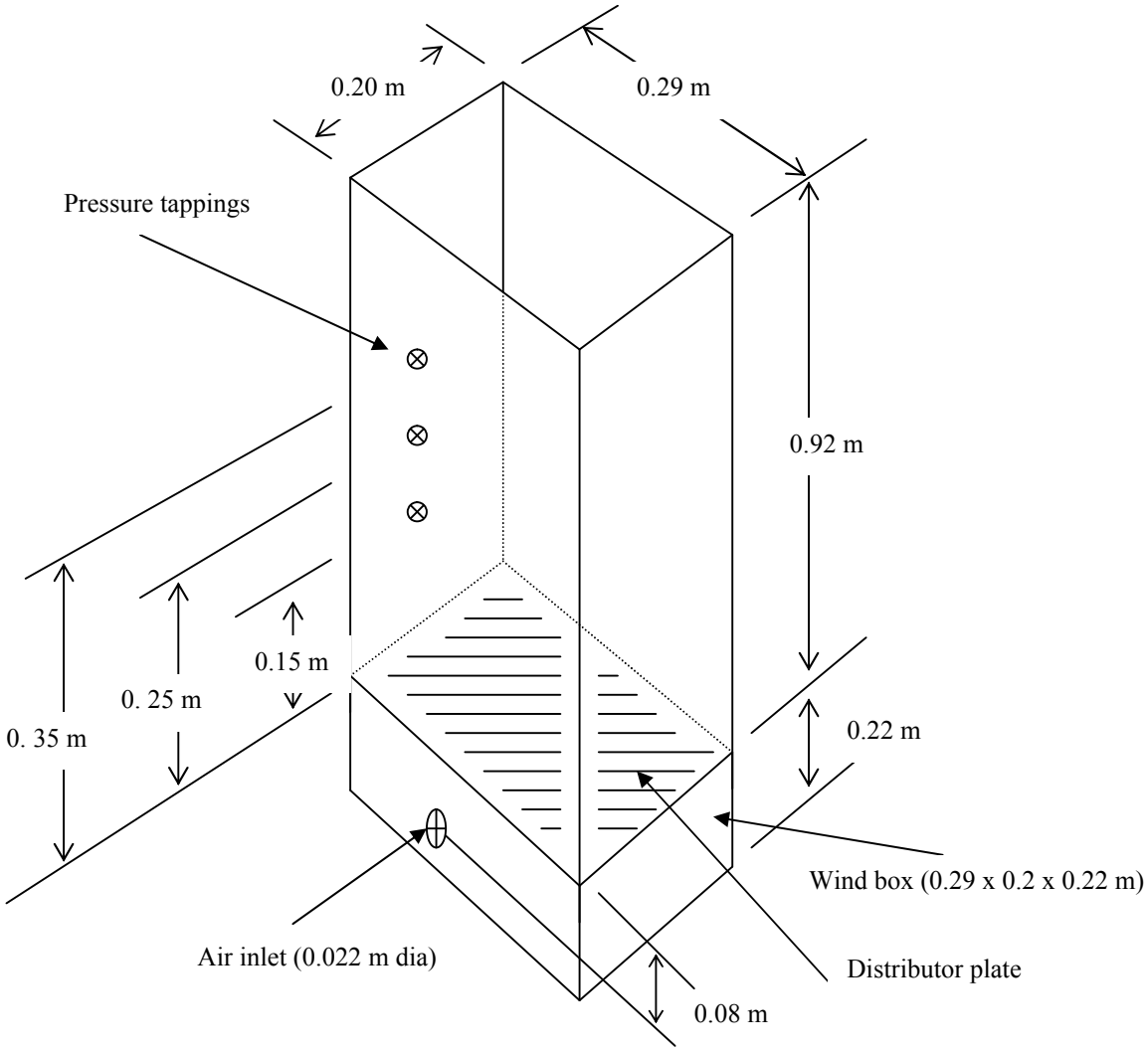


Figure1: Fluidised Box (dimension in m)

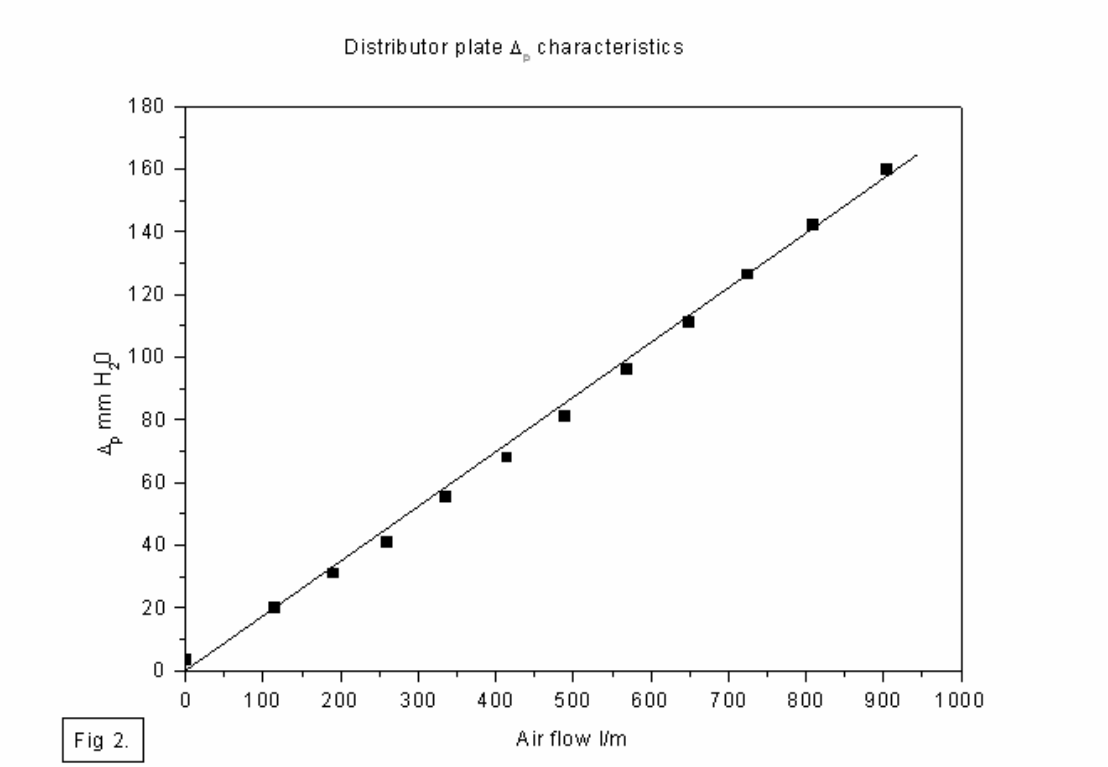


Figure 2: Characteristic curve of distributor plate

Operating Conditions

- **Material A**

Run Conditions	
Outlet Pressure (Pa)	Ambient
Temperature (K)	291

Gas Phase: Air *			
r(kg/m3)	1.20	Run A1 UG (m/s)	0.262
μ (Pa.s)	0.000019	Run A2 UG (m/s)	0.315

*Outlet Conditions

Solid Phase: A Ion Exchange Resin			
dps/dp50 (micron)	805/???	Rhos (kg/m3)	1170
j	1	Bed inventory(kg)	16
Size Distribution	See XLS sheet	Bed height at rest (m)	0.43

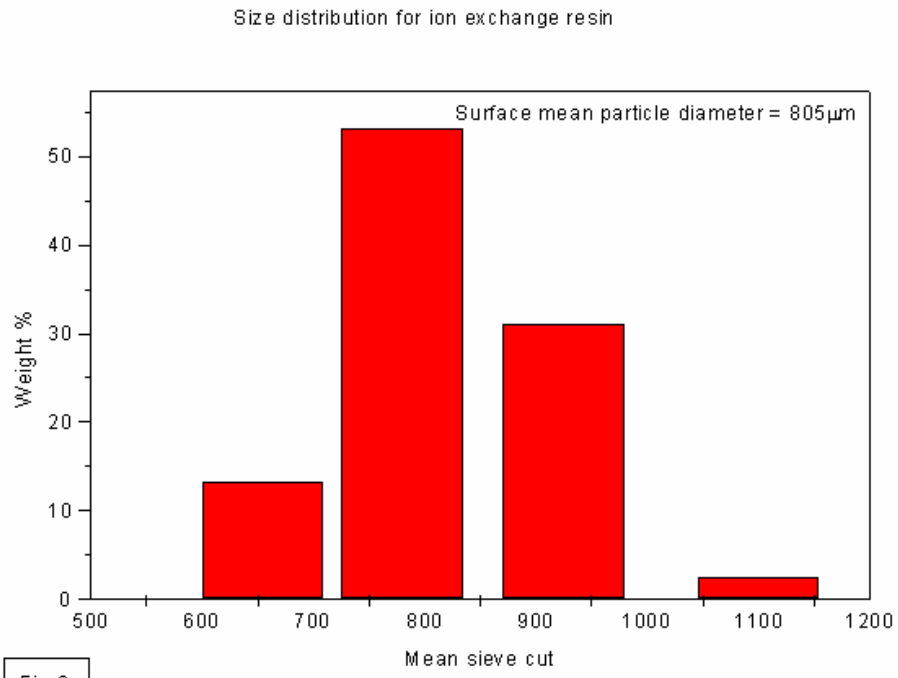


Fig 3.

- **Material B**

Run Conditions	
Outlet Pressure (Pa)	Ambient
Temperature (K)	294

Gas Phase: Air *			
r(kg/m3)	1.20	Run B1 UG(m/s)	0.0104
µ(Pa.s)	0.000019	Run B2 UG (m/s)	0.0182

*Outlet Conditions

Solid Phase: B Laport UG aluminia			
dps/dp50 (micron)	62/???	Rhos (kg/m3)	1770
j	0.78	Bed inventory (kg)	27
Size Distribution	See XLS sheet	Bed height at res (m)	0.43

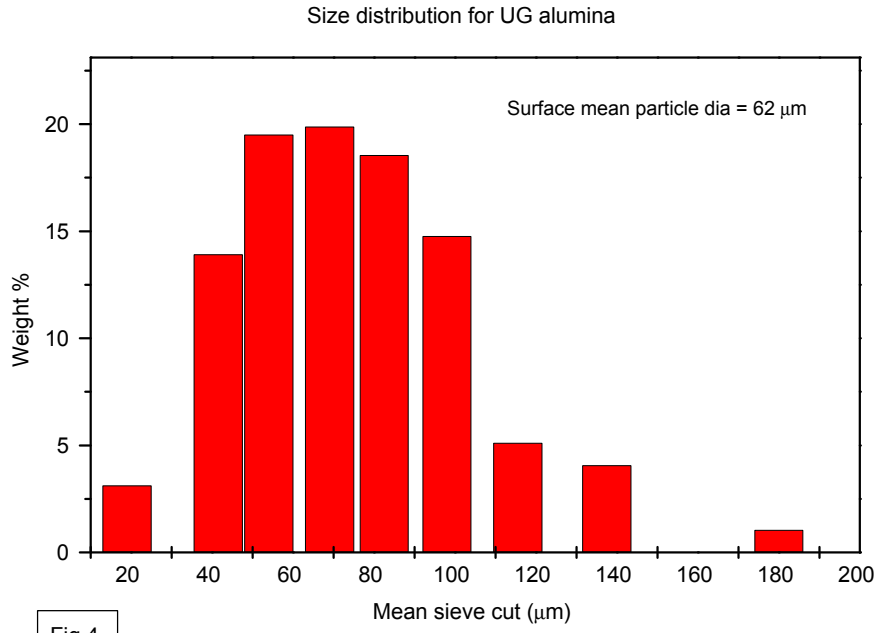


Fig 4

Experimental data

Experimental data and X-ray images are provided for comparison with data derived from models and modelling simulations, the following:

- Bed height averaged
- Time series Δ_p measurements using pressure tappings (no damping or filter used) as in Fig 1. Using a total sampling time of 20s at a frequency of 20Hz
- X-ray radiography (video) showing the structure of the bed :
  Average visible Bubble size at two bed heights (X-ray centre line) 20 & 40 cm above.distributor The observed window is a circle of 15 cm diameter (Fig.3) In the window, the solid volumetric fraction map measured is obtained by integration across the depth of the bed
  Average bubble velocities at same heights.
  Dynamic record of solid volumetric fraction.

Specific Technique : X-RAY EQUIPMENT

The equipment is housed in a dedicated room. This room contains the X-ray generator, tube and image intensifier. The main control console is located outside the room and all X-ray operations are carried out from this location.

The X-ray tube and image intensifier are mounted on a twin column ceiling suspension unit, which allows the columns to be moved along the length of the room whilst the lateral movement of each column independently permits the distance between the tube and intensifier to be altered. Each of the columns can be moved in the vertical plane either independently or synchronised as a pair. This motion is motorised and can be remotely controlled from outside the room.

The "Todd research" Triton MkIV generator/control console comprises two units. The generator is an oil immersed high-tension transformer and associated electronics. The use of electronic switching of the secondary

circuit of the transformer by means of high voltage vacuum triode valves, allows exposure times of less than 0.001 sec to be achieved.

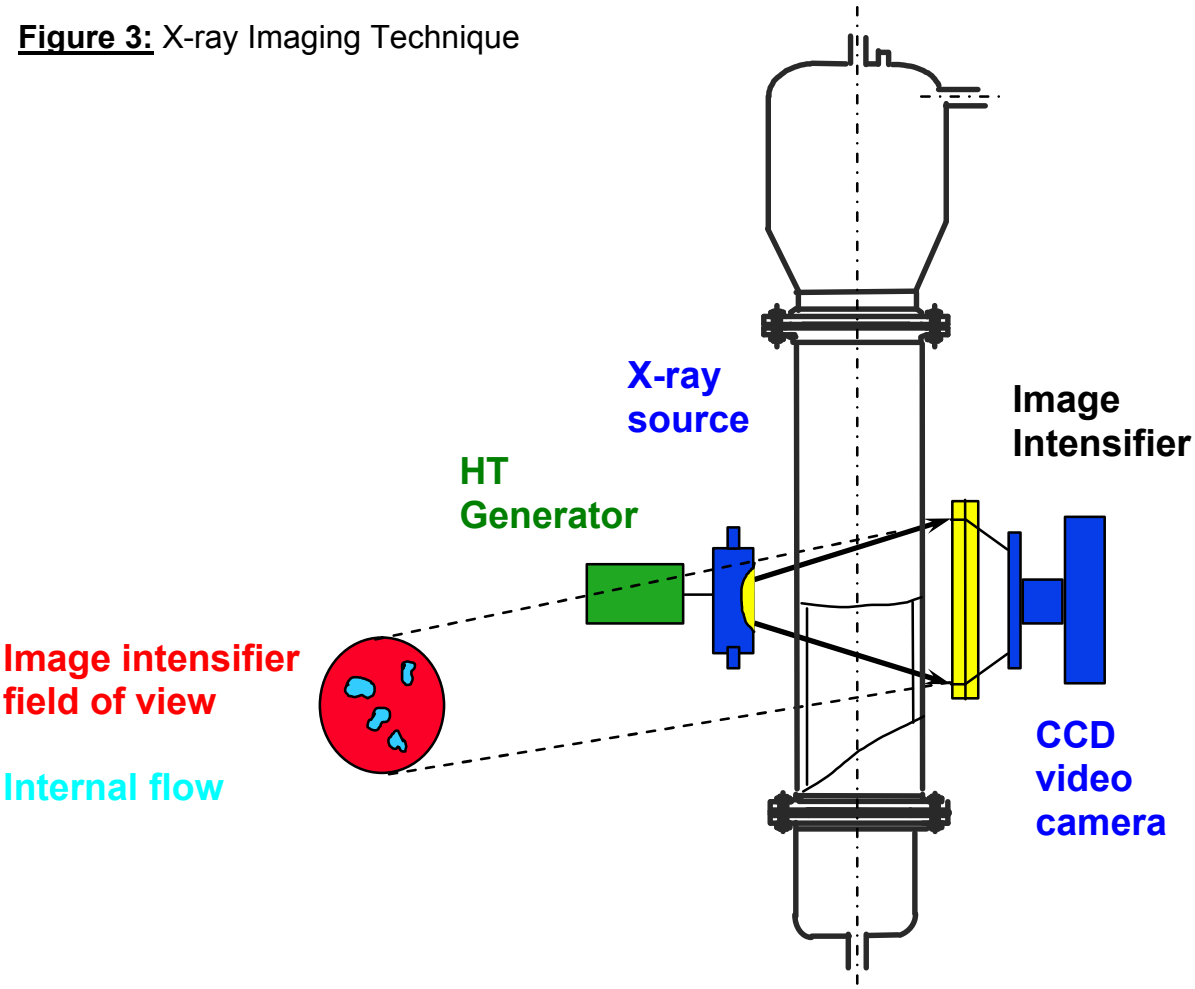
There is provision for up to three X-ray tubes to be connected to the unit albeit that only one tube can be operated at any one time. The control console is housed in a 19" rack unit and incorporates all the necessary circuitry for kV, mAs and mA selection, together with the safety interlocks and overload protection system. Exposure times are controlled by a solid state mAs timer designed especially for this X-ray apparatus, thus permitting ultra short exposure times at frequencies up to 150 Hz for cine (video) radiography operation.

The "Machlett" Dynamax Super 50-60(B) X-ray tube used is designed to operate up to 150 kVp, the anode rotation speed being in excess of 10,000 rpm. This higher anode speed, as compared to the usual speed of 3,000 rpm permits an increase of up to 70% in short exposure radiographic ratings. Increased rotational speed is obtained by application of higher stator power supply frequencies. The tube has dual focal spots of 1mm and 2mm. The anode has exceptionally high loading capabilities, being constructed of molybdenum, faced with a rhenium tungsten alloy.

The image intensifier used is a "Thompson" model 9432 HP. This unit has triple input fields of 12" (300mm), 9" (230mm) and 6" (150mm). The image brightness is electron-optically intensified. This is achieved primarily by acceleration of the electrons and secondarily by reduction of the image size. The Maximum conversion factor (intensification on the output (viewing) screen) is $240 cd.m^{-2}/mR.s^{-1}$. The 12" (300mm) field is used when one wishes to cover the largest possible area of the subject under investigation. For close study of a particular zone of interest the 9" (230mm) or 6" (150mm) fields can be used, which since they likewise cover the total viewing screen the detail is enlarged resulting in finer detail being seen and recorded.

The X-ray system can be used for Fluoroscopy (screening), Radiography (single shot) and Cine (video) radiography. When operating in the fluoroscopy mode the X-ray tube anode is not rotating therefore the Kv and mA settings are restricted.
The image from the image intensifier is captured using a CCD video camera The pictures are recorded using a S-VHS video recorder and displayed on a monitor located outside the X-ray room.

Figure 3: X-ray Imaging Technique



Calculation Request

- Bed height,
- Local time pressure series,
- Dynamic bubble across the X ray window:
  . Diameter
  . Velocity
  . Frequency
  . Dynamic record of solid volumetric fraction map

Specific attached xls sheet are proposed for the presentation of the numerical results.