The amount of solids maldistribution in parallel cyclones was investigated to determine what parameters affected the maldistribution. In many fluidized bed processes with parallel cyclones (as many as 20 in parallel in some cases), it has been noted that unequal erosion (wear) can occur in the cyclones. This results in very short run lengths in order to repair the cyclones with the most wear. This unequal wear has been attributed to unequal solids distribution to the cyclones. In addition to the increased wear, cyclone efficiencies are affected as well.

In the specific concern that generated this study, it was found that parallel cyclones in fluidized-bed cokers at Syncrude Canada Ltd. (Syncrude) had unequal amounts of coke buildup on them. This coke buildup on the cyclones causes increased backpressure on the fluidized-bed coker, and after a certain pressure is reached, results in shutdown of the coker. Hot scouring coke, presented at the cyclone inlets, is used to combat the coke formation that is caused by condensation of heavy hydrocarbons. Understanding the scouring coke distribution into the parallel cyclones could lead to reduced deposit maldistribution and increased run length.

The testing to determine what causes solids maldistribution in parallel cyclones was conducted using four, 30-cm diameter parallel cyclones that were located above a 0.9-m diameter fluidized bed. Solids flows into the freeboard above the fluidized bed were from the fluidized bed itself and from two pneumatic conveying lines that simulated the lines entering the freeboard of the Syncrude Canada Ltd (Syncrude) fluidized bed coker. The testing was conducted at ambient temperature and pressure using a coke material with a median particle size of 156 microns.

The results of the testing showed that although the pressure drop across the cyclones were essentially equal, the gas and solids flow rates through the cyclones could vary significantly. By closing a valve in the dipleg of each of the test cyclones and measuring the rate of buildup of solids in each dipleg, the solids flow rate through each cyclone could be determined.

Tests were conducted to vary the gas flow rate through the bed, the amount of solids flow through each pneumatic conveying line and the amount of gas flowing through each cyclone. Depending on conditions, it was found that the ratio of the solids flow rate through the highest-loaded cyclone to the lowest-loaded cyclone could be as much as a factor of four.

It was found that the solids distribution in the freeboard above the bed determined the solids flow distribution into each cyclone. Changing the gas flow rate through the cyclone did not affect the solids distribution through the cyclones. It appears that the solids distribute to the cyclones based on the solids distribution at the entrance to the parallel cyclones. The gas flow then distributes itself in order to equalize the pressure drop across the cyclones.