This paper considers a wide range of powder diffraction techniques that can be used to monitor industrial reactions and transformations occurring at elevated temperatures and various environments.

For slow industrial furnace cycles (>24 hours) laboratory high temperature powder cameras can be modified and used invariably with some chemical modification to the sample and positive environmental (gas) control when powder surface decomposition is excessive compared to the real large scale industrial furnace: these points will be illustrated using the furnace-production of pigment-Ultramarine as an example.

For reactions taking place over 2-10 hours, a laboratory diffractometer with specially-designed environmental cells and position-sensitive detector has been used to collect diffraction data over 5-10 minute intervals, using a range of temperatures and gas pressures up to 10 bars. This combination is illustrated using the calcination of zirconium hydroxide to zirconia up to 900°C and the hydration or Portland cements under ambient and steam (autoclave) curing conditions. Even faster data collection rates are required for studying polymorphic transformations in pharmaceutical products.

Most of these dynamic studies have also been performed using neutron and synchrotron X-ray sources. In the case of neutron diffraction, the quality of data is sufficient to enable the non-crystalline water fraction to be resolved powder diffraction techniques.

This study demonstrates that quite complex reaction cycles can now be studied using a variety of time-resolved powder diffraction techniques.

A procedure for the crystallographic analysis of urine is described. In a study involving 112 patients with renal disease and 20 normal subjects, the diffraction patterns of urine (solids) were recorded. There were significant differences between the diffraction patterns recorded, respectively, from the urine of patients with glomerulonephritis, patients with pyelonephritis, and the controls. The simplicity of the method suggests that it may have wide clinical applications.