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Looking inside iron ore pellets

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About 25 % of the world´s iron ore production of about 1,1 billion metric tons per years is traded as iron ore pellets. These spheres with diameter between 8 and 16 mm are made of iron oxide ore powder (100% - 150 µm), additives to adjust the chemical composition for the individual blast furnace operations and binders to control the compressive strength during the production process of pelletizing, drying and firing for final hardness (compressive strength of 2000 N). Sodium rich natural or activated bentonites are the most common binders used in a mass proportion of 0,7 to 1,5 % within a pellet. Due to their schist structure and chemical composition they are able to incorporate water in the structure causing swelling, followed by dissolution to a colloid gel of high viscosity depending on the amount of water added. According to the common theory of pelletizing the strength of a bentonite bonded humid pellet exceeds that of the simple water bonded due to the even distribution of the gel in the capillary system. This is in contradiction to the technical mixing process during pellet production providing neither sufficient homogenization nor residence time for the formation of the gel.
Controlled drying experiments observed by neutron imaging at ICON/ PSI allowed to study the drying process by time resolved 2D radiography completed by neutron tomography of humid and dry pellets. Single humid pellets rolled under industrial conditions with and without bentonite were positioned into a specially designed climate chamber for constant temperature and moisture content and centered in the beam. The drying event was imaged for 2 hours at high resolution (25 x 25 mm frames) and 90 sec exposure time. Radiography allowed to record the drying process with time for selected points in the cross cut of the pellets. Tomography provides information about the allocation of the bentonite within the volume of the pellet.

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