INTRODUCTION

Pulverized coal injection (PCI) is a common practice in modern-day blast furnace ironmaking. The primary goal of PCI is to reduce expensive coke consumption on a per tonne basis of hot metal production, commonly referred to as coke rate. The capability of PCI in reducing the coke rate is quantified by the coke replacement ratio (CRR). CRR is coal specific and is defined as coke rate reduction by unit mass of PCI. Numerous correlations have been put forward in the literature for calculating CRR from chemical composition and calorific value of PCI coal.

An important factor that determines the actual CRR is the combustion behavior of PCI coal upon rapid heating. When pulverized coal is introduced into a hot blast, the coal particles undergo very rapid pyrolysis [1, 2]. Upon heating, the outer surface of a coal particle first undergoes softening which then propagates toward the particle center, releasing gases as heating continues, causing the coal particle to swell. Due to the extremely fast heating of coal particles, the outer surface reaches resolidification temperature prior to its center reaching softening temperature. As a result, coal particles are not able to maintain a fluid state throughout the whole particle. Due to the extremely fast heating of coal particles, the outer surface reaches resolidification temperature prior to its center reaching softening temperature. As a result, coal particles are not able to maintain a fluid state throughout the whole particle. The residual solid after eruption forms cenospheres [3]. The eruption of a coal particle also leads to the explosive release of gas and ejection of tar droplets into the hot blast. The rapid heating of these droplets results in dehydrogenation and solidification. The solid particle produced is referred to as blast furnace soot [4].

CanmetENERGY has setup an experimental injection rig to simulate the combustion of pulverized coal in conditions similar to those of industrial blast furnace tuyeres [5]. Since the commissioning of this rig in 2015, more than 20 coal samples have been tested and valuable information on the combustion behaviour of coals has been collected. The rig and experimental procedure was recently upgraded to allow systematic evaluation of combustion behavior of coal upon rapid heating.

A carbon type differentiation (CTD) technique was also developed at CanmetENERGY to quantify different types of carbonaceous materials (char, coke, soot) in blast furnace dust and sludge samples. The technique has been successfully