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Biogas as a co-firing fuel in thermal processing industries: implementation in a glass melting furnace

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Abstract

In many energy-intensive manufacturing processes, natural gas is the dominant fuel to provide process heat. There is increasing pressure, however, to reduce both fuel costs and carbon dioxide (CO2) emissions. One possible approach in this regard is the use of mostly untreated biogas as a fuel in a co-firing approach. While the use of such biogas can decrease both natural gas consumption and overall CO2 emissions (biogas is considered to be a CO2-neutral fuel), there is concern how this change of fuel will impact on product quality, combustion behavior and the refractory material. Trace contaminations in the biogas are one aspect in this context which might have a negative impact on product quality or the durability of the refractory of industrial furnaces.
In a previous research project, GWI and its partners investigated the principal applicability of biogas combustion, using the glass melting process as an example. It was found that there was no negative impact on combustion behavior, product quality or refractory properties if the process is adapted to the different characteristics of the fuel, for example by adjusting melting times. Another result was that for existing plants, it is more sensible to use a co-firing approach, partly substituting natural gas by biogas, instead of switching fuels completely.
Consequently, the co-firing of roughly de-sulphurized biogas in an industrial glass melting furnace in Germany is currently being investigated as part of a follow-up project.
Aspects such as pollutant formation, energy efficiency and product quality when using untreated biogas on an industrial scale will be examined.

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1. Introduction

The relationship between the utilization of carbon-based fuels to provide energy and global warming is continuing concern for the world community. Since carbon dioxide (CO_2) has been identified as one of driving forces for the Greenhouse Effect, the question remains how to reduce anthropogenic CO_2 emissions and at the same to supply energy to a growing world population.

Today's energy systems are still very much dependent on the combustion of carbonaceous fuels such as coal, mineral oil or natural gas. This is not only true for electricity generation and transportation, but also for the wide field of industrial manufacturing processes which often require significant amounts of energy to produce products made from metals, plastics, ceramics or glass. In Germany, about 29 % of the nation's end energy consumption is due to industrial processes [1]. In the U.S., industry contributes about 22 % to the total end energy consumption [2].

For many industries, natural gas is the dominant source of energy, especially when it comes to process heating. About 60 % of the process heat in German industries are produced by means of natural gas [3]. In some industries, the share is much higher: in the glass industry, for example, natural gas provides about 90 % of the total process heat.

Policy-makers stated ambitious objectives to significantly cut anthropogenic CO_2 emissions. The German Federal government, for example, aims to reduce the country's CO_2 emissions by 40 % (compared to the state of 1990) while at the same time increase the share of renewable energy sources in the energy supply to 18 % by 2020 [4]. Major energy consumers like the industrial sector will have to do their part if these objectives are to be achieved.

In principle, there are two ways to reduce the CO_2 emissions of an industrial combustion application which uses a carbonaceous fuel. The first would be to improve to efficiency and hence fuel consumption of the process. Efficiency is a traditional focus of industrial optimization efforts since it translates directly into reduced operational cost, which is always a driving force in industry. Figure 1, taken from [5], shows the historic development of the specific energy consumption in the container glass industry over roughly a century as an example.

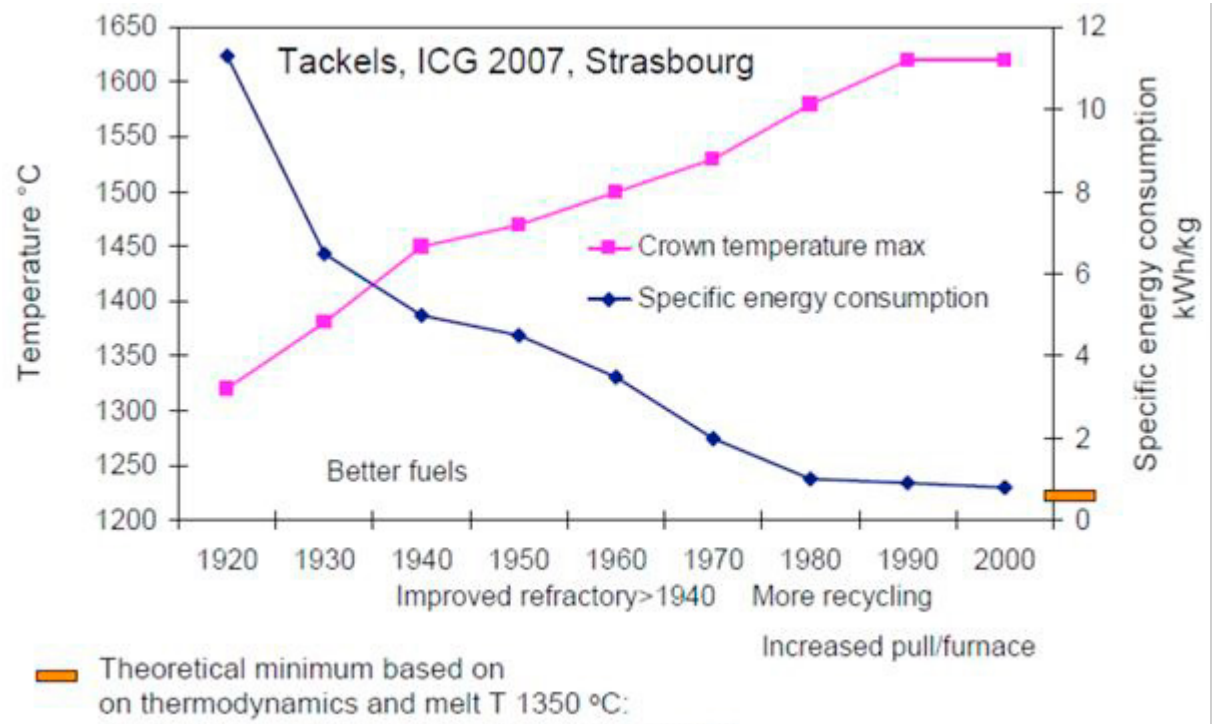

Figure 1: Evolution of specific energy consumption and process temperatures in the container glass industry [5]