

Oil from Coal:

THE SEARCH FOR ENERGY INDEPENDENCE IN NAZI GERMANY

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ABSTRACT

As the need for petroleum products steadily increased during the onset of the twentieth century, access to petroleum reserves became strategically important for all nations. This presented a problem for Germany, a country that during the time had become known for its increasingly more isolationist policies, because Germany has limited domestic petroleum resources. In turn, Germany began investing in alternative forms of energy to adjust for inadequacies in its energy sector, that ultimately resulted in the development of coal hydrogenation processes. These processes became even more essential during WWII, when access to foreign oil became heavily restricted.

INTRODUCTION

- Due to limited access to resources, Germany investigated several alternate energy sources in an effort to become energy independent in the early twentieth-century^[7]
- This effort was heightened during WWII, when access to oil was heavily restricted due to embargoes and sanction^[8]
- Conversion of coal to liquid hydrocarbons was seen as a viable method, due to abundant domestic coal reserves^[7]
- Germany primarily used two methods for liquefying coal: indirect (Fischer-Tropsch) and direct (Bergius) hydrogenation^[5]

DIRECT HYDROGENATION

- Method used by Germany is known as the Bergius process, which was invented by Friedrich Bergius in 1913, for which he later won the Nobel Prize in Chemistry in 1931^[1, 2, 7]
- Dried and pulverized either brown coal or bituminous coal added to heavy oil which was recycled from the process to produce a slurry; a catalyst (usually iron oxide) was then added to the slurry and performed at high temperatures (400-600°C) and pressures (200-700 atm)^[2, 5]
- Produced high grade petroleum products such as aviation fuel that was directly useable^[6]
- Light oil fractions were upgraded into higher grade products using hydrogen enriched steam; The heavy fractions were recycled and used to form the slurry required for the process^[9]
- Bergius was more prominent for several factors including the difference in end products, the availability for the raw materials needed^[6]

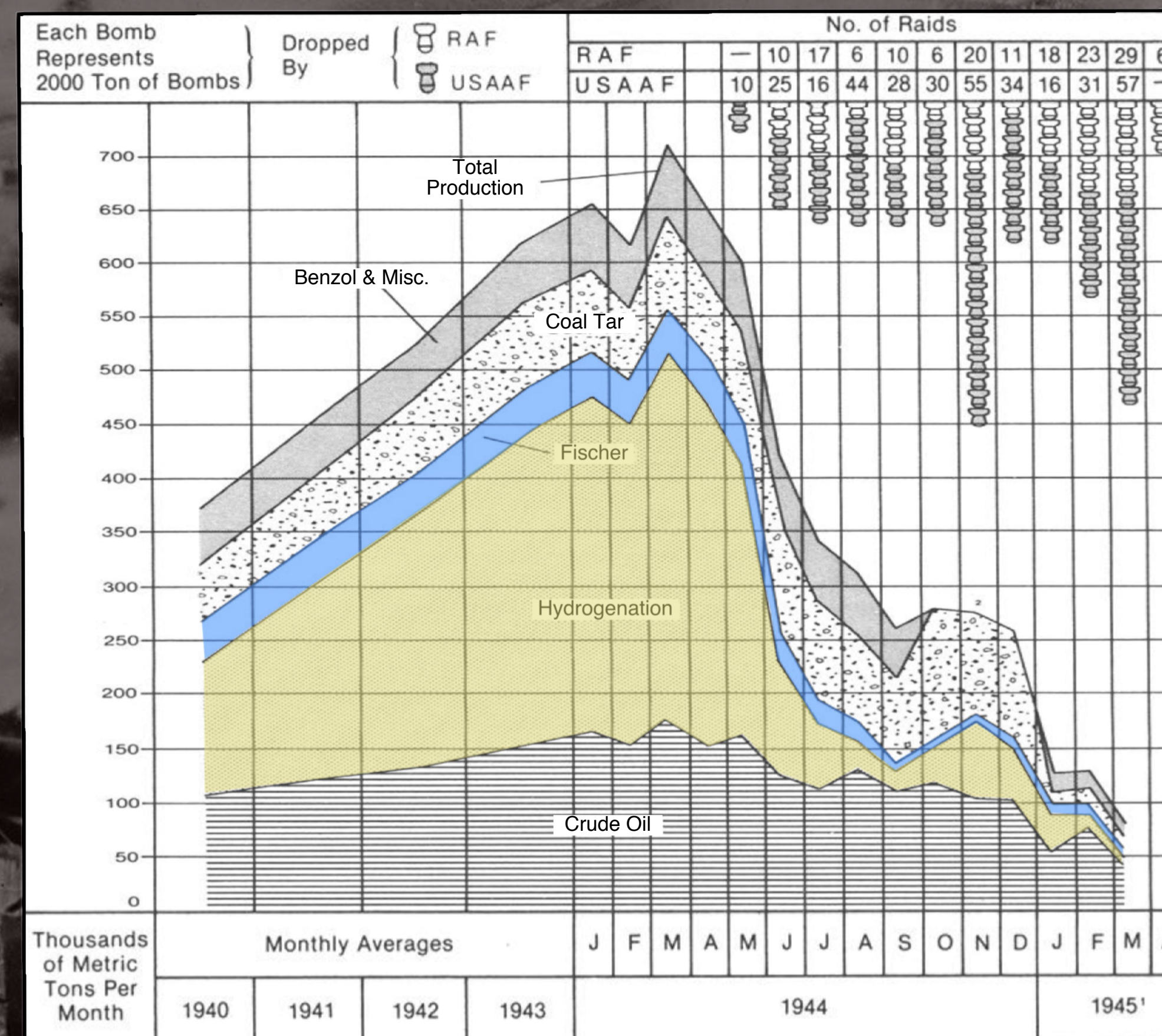


Figure 1: Production of petroleum products in Germany by process^[6]

Graph showing production of oil from direct hydrogenation (in yellow) and indirect hydrogenation (in blue). Modified from Stokes (1985).

INDIRECT HYDROGENATION

- The type of indirect hydrogenation used by Germany is known as the Fischer-Tropsch process^[1]
- This method was used to synthesize liquid fuels from a mixture of hydrogen and carbon monoxide^[10]
- Process occurs at fairly low temperatures (~200°C) and pressures (20 atm)^[6]
- Uses water and carbon monoxide to form hydrocarbons^[9]
- Synthesis gas is formed by passing steam over red-hot coke to produce liquid hydrocarbons^[9]
- Provided mostly lower grade crude oil which was refined to produce gasoline, diesel fuel and waxes^[6]

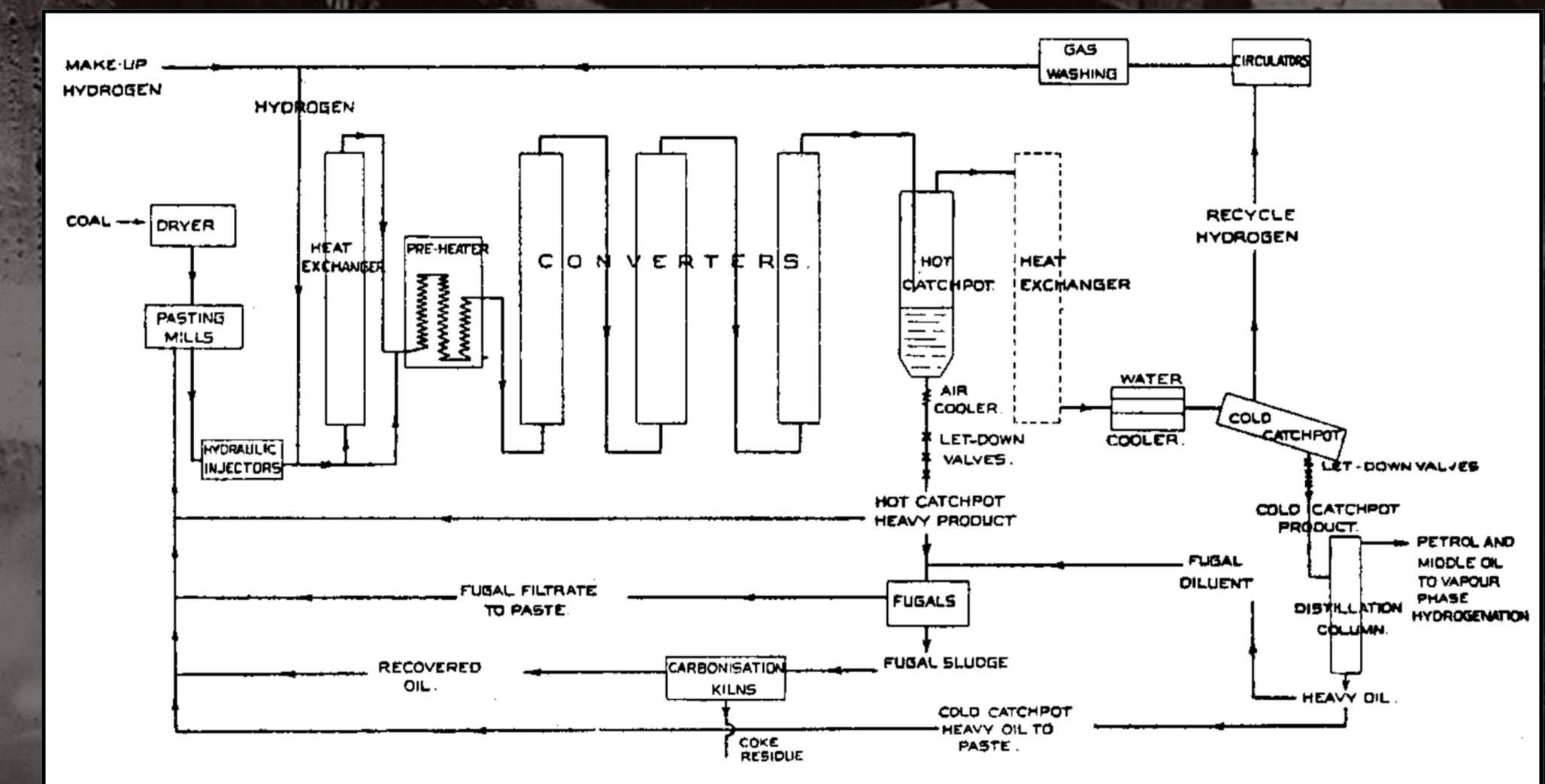


Figure 2: General scheme for the hydrogenation of coal^[5]

CONCLUSION

- Comparatively, the Fischer-Tropsch process produced significantly less oil during the war relative to Bergius processes, with yearly output of Fischer-Tropsch reaching 585,000 metric tonnes/year against 3,250,000 metric tonnes/year^[5]
- In 1943, 12 hydrogenation plants were running in Germany. These plants provided 98% of the aviation fuel and 47% of the total hydrocarbons consumed in Germany during World War II^[10]
- Many of the coal hydrogenation plants were destroyed by Allied bomber aircrafts, slowing down and in some cases halting all operations; helping to secure an Allied victory^[3, 5, 6]
- After WWII, investment into coal hydrogenation diminished due to the rise of cheap and abundant oil from the Middle East^[9, 10]

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