CCCLI.—*An Investigation on the Ceria–Thoria Catalysts.*

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It has been shown by Swan (J., 1924, **125**, 780) that, of all the mixtures of ceria and thoria, that used in the gas mantle (CeO_2 1%; ThO_2 99%) is the most efficient for bringing about the oxidation of hydrogen. The present investigation was undertaken to determine whether this mixture was also the most efficient for the combustion of other gases, the gas chosen being carbon monoxide.

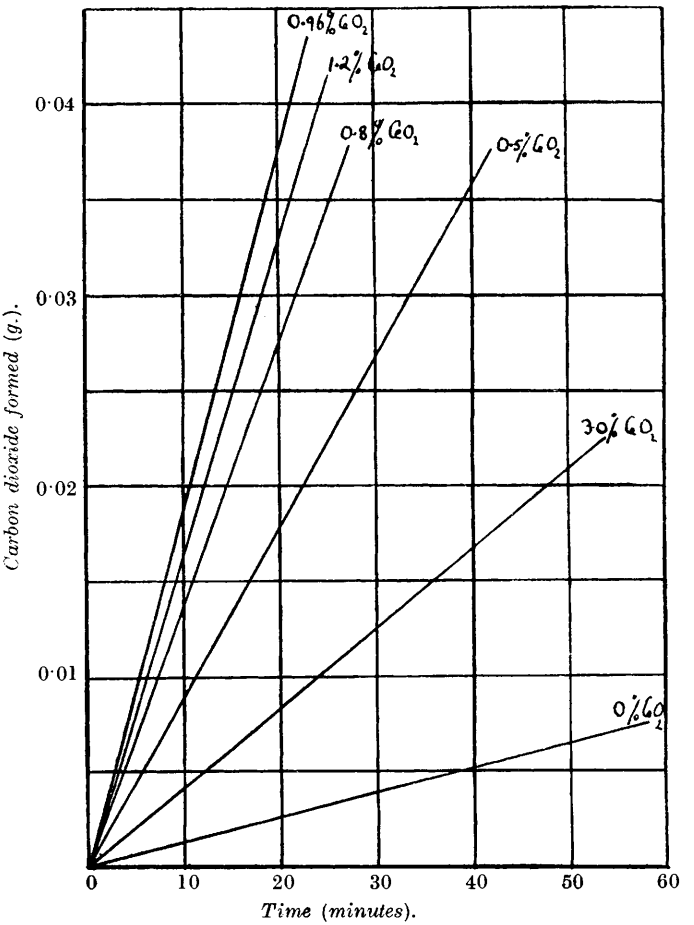
Thorium nitrate was purified by the method of Neish (*J. Amer. Chem. Soc.*, 1904, **26**, 781), the details being essentially the same as those used by Swan (*loc. cit.*). Cerium ammonium nitrate was prepared by the method of Imry (*Z. anorg. Chem.*, 1927, **164**, 781) and recrystallised three times from 10·5*N*-nitric acid. Carbon monoxide, prepared from redistilled formic acid and pure sulphuric acid, was mixed with pure oxygen, prepared from potassium permanganate, in the proportion of 2 : 1 by vol.

The solutions of the nitrates were mixed in the requisite proportions and the mixed oxalates were precipitated with recrystallised oxalic acid and boiled with a slight excess of oxalic acid to reduce the ceric salt to the cerous state, the same quantity of oxalic acid being used in each case. The precipitates were filtered off, and ignited to constant weight at as low a temperature as possible; they were then sieved, made into a paste with water, spread evenly on thin glass slips (2·2 × 0·4 mm.), and dried at 140° for 5 hours.

Experiments were at first conducted in an apparatus similar to Swan's (*loc. cit.*), but unsatisfactory results were obtained on account

of the accumulation of the carbon dioxide over the catalyst and the impossibility of starting to take readings at corresponding times. The following experiments were made by passing the carbon monoxide–oxygen mixture (freed from carbon dioxide) at constant

FIG. 1.



pressure through a flow-meter over the catalyst in a hard-glass tube in the furnace, collecting the carbon dioxide formed in two flasks containing barium hydroxide of known strength, and titrating the excess of barium hydroxide, phenolphthalein being used as indicator. Care was taken that the catalyst was always in the same part of the tube so that the pre-heating of the gases should be the same in all

cases. The glass slip was put flat on the bottom of the tube. The temperature employed was 485°.

The following were the results obtained, each experiment being made with a different catalyst-slip. It is seen that the rate of formation of carbon dioxide (dc/dT) attains a maximum at 0·96% of ceria (see also Fig. 1), and hence that the catalyst which Swan had found to be most efficient in the oxidation of hydrogen is also the most efficient for that of carbon monoxide.

Catalyst, $\%CeO_2$.	Time, mins.	CO_2 formed, g.	$10^4 \times dc/dT$.	Mean.
0	60	0·0079	1·317	
	60	0·0077	1·283	1·30
	60	0·0079	1·317	
0·5	40	0·0362	9·05	
	30	0·02745	9·15	9·0
	30	0·0265	8·83	
0·8	30	0·0410	13·67	
	30	0·0436	14·53	14·0
	30	0·0415	13·83	
0·96	15	0·0270	18·0	
	15	0·0268	17·85	18·0
	15	0·0274	18·25	
1·2	15	0·0240	16·00	
	15	0·0245	16·35	16·2
3·0	60	0·0287	4·78	
	30	0·0121	4·02	
	30	0·0131	4·37	4·3
	30	0·0125	4·17	

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