Identification of certain anions and cations in mixtures by means of the formation of coloured (ring) products on agar gel

Part 1. Identification of anions and cations on gel containing the test reagent

Introduction. When a suitable reagent is added to a solution containing two ions both of which react with the reagent, the identification of the ions is not possible. Some work has already been done on the detection of ions in mixtures by using filter-paper strips impregnated with agar gel containing the detecting reagent[1–3]. This paper describes a simple method for detecting such ions, without the use of any elaborate apparatus, by means of the formation of coloured rings on agar gel supported on a horizontal glass plate. The relative position of the coloured rings has been found to be dependent on the solubility of the products involved, the less soluble product forming the inner ring.

Experimental. Agar, B.D.H., L.R. grade (fine powder) was used in the experiments. It was found to be free from all ions except negligible traces of chloride ions.

TABLE I

Sample No.	*Ions contained in the mixture*	*Detecting reagent*	*Inner ring*		*Outer ring*	
			Colour	*Reacting ion*	*Colour*	*Reacting ion*
	Anions					
1	Ferrocyanide and thiocyanate	Ferric chloride	Blue	Ferrocyanide	Red	Thiocyanate
2	Ferrocyanide and ferricyanide	Copper sulphate	Chocolate	Ferrocyanide	Yellow	Ferricyanide
3	Ferricyanide and ferrocyanide	Silver nitrate	Orange	Ferricyanide	White	Ferrocyanide
4	Iodide and ferricyanide	Silver nitrate	Yellow	Iodide	Orange	Ferricyanide
5	Iodide and chloride	Silver nitrate	Yellow	Iodide	White	Chloride
6	Sulphide and iodide	Mercuric chloride	Black	Sulphide	Orange	Iodide
	Cations					
1	Nickel and cobalt (as complex ammines)	Rubeanic acid	Blue	Nickel	Yellow-brown	Cobalt
2	Ferric and titanic	Cupferron	Red	Ferric	Yellow	Titanic
3	Ferric and titanic	Potassium ferrocyanide	Blue	Ferric	Green	Titanous
4	Ferric and manganous	Potassium ferrocyanide	Blue	Ferric	White	Manganous
5	Copper and cadmium	Potassium ferrocyanide	Chocolate	Copper	White	Cadmium
6	Lead and silver	Potassium chromate	Yellow	Lead	Red	Silver
7	Thorium and uranyl	Alizarin sulphonic acid	Pink	Thorium	Bluish violet	Uranyl

1% agar gel was prepared by boiling agar for a few minutes with water and the concentration of the reagent incorporated in the gel was adjusted to about $N/100$. Test solutions contained equal volumes of $N/2$–$N/20$ solutions of each ion. A thin layer of the gel containing the reagent was allowed to spread on a glass plate and one drop (0.05 ml) of the test solution was placed at the centre of the gel before it was allowed to set. It was observed that distinct rings for different ions were obtained within 2 to 4 hours at room temperature (about 25°). The results are given in Table I.

Part 2. Identification of certain anions on gel containing silver chromate

Introduction. Filterpaper impregnated with silver chromate has been used for detection of halide ions[4]. In the present investigation finely dispersed silver chromate in agar gel has been employed and a separation of halides and other anions has been obtained.

Experimental. A fine dispersion of silver chromate in agar gel was obtained as follows: to 80 ml of hot 1% agar gel were added 10 ml of $N/10$ silver nitrate solution followed by a slight excess of $N/10$ potassium chromate solution. The procedure for detection of the anions was the same as adopted in Part 1; the results are given in Table II.

TABLE II

Sample No.	*Anions contained in the mixture*	*Inner ring*		*Outer ring*	
		Colour	*Reacting ion*	*Colour*	*Reacting ion*
1	Sulphide and chloride	Black	Sulphide	White	Chloride
2	Iodide and sulphide	Yellow	Iodide	Black	Sulphide
3	Iodide and ferricyanide	Yellow	Iodide	Orange	Ferricyanide
4	Iodide and arsenate	Yellow	Iodide	Chocolate	Arsenate

Conclusions

This investigation provides a simple method of detecting certain anions and cations in mixtures when they are present in quantities of the order of 2 mg per ml, which normally require more elaborate methods. The coloured rings for various ions can readily be obtained in a state of transparency and, with suitable experimental modifications, they may be employed for colorimetric estimations. The above technique also provides a method for determining the comparative solubilities of insoluble substances.

The authors express their sincere thanks to Prof. T. R. SESHADRI, Head of the Department of Chemistry, for helpful suggestions and for his keen interest in this work.

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Received November 24th, 1958