samples treated with aqueous extracts or solutions of fertilising materials.

Temperature thus seems to be a physical factor of considerable importance in the formation of suitable aggregates in soil, which facilitate æration and productivity of the soil. The presence of decomposing organic matter also contributes considerably to soil aggregation. Liming the soil has been known to aid its productivity, presumably by flocculation or aggregation. Among the physical, chemical and biological factors influencing soil structure, temperature is apparently of some special significance to tropical agriculture.

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PREPARATION AND PROPERTIES OF BISCYCLOPENTADIENYL TUNGSTEN OXYDICHLORIDE AND BISINDENYL TUNGSTEN OXYDICHLORIDE

S. P. ANAND, R. K. MULTANI AND B. D. JAIN

Department of Chemistry, University of Delhi, Delhi-7

TUNGSTEN cyclopentadienyl chlorides,[1] carbonyls[2] and hydrides[3] have already been reported. No work has however been done on the preparation of indenyl derivatives of tungsten, although indenyl derivatives of iron and cobalt,[4] tin,[5] lead,[6] gallium and mercury[7] have been reported by various workers. The present communication deals with a study of preparation and properties of biscyclopentadienyl tungsten oxydichloride (I) and bisindenyl tungsten oxydichloride (II). These compounds have been prepared by direct reaction of tungsten oxytetrachloride with cyclopentadiene as well as with indene in liquid phase using tetrahydrofuran. Compounds (I) and (II) so formed were isolated by removing the solvent under reduced pressure and subsequent recrystallization from THF or diethyl ether. The percentage yield was nearly 80%. Tetrahydrofuran has proved to be a satisfactory medium for carrying out the reactions of tungsten oxytetrachloride with cyclopentadiene and indene.

EXPERIMENTAL

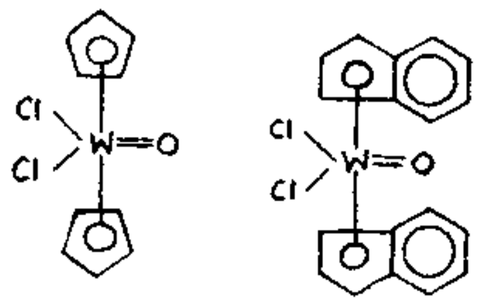
Tungsten oxytetrachloride was prepared by refluxing tungsten trioxide with thionyl chloride and the excess of thionyl chloride was removed by evaporation under reduced pressure. The bright reddish mass so formed was sublimed at 130–35° and yielded scarlet red needles.

Preparation of Biscyclopentadienyl Tungsten Oxydichloride.—To 3·5 gm. of tungsten oxytetrachloride (0·1 mole) in 100 ml. of tetrahydrofuran was added 2·7 ml. of cyclopentadiene (0·2 mole) and the mixture was refluxed for 6–7 hours at 75°–80° C. The resultant deep brown solution was freed from solvent by evaporation under reduced pressure and on repeated crystallization from tetrahydrofuran gave light pink crystals (Found : C, 29·9 ; H, 2·5 ; W, 45·9 ; Cl, 17·6% ; Calc. for $(C_5H_5)_2WOCl_2$: C, 29·92 ; H, 2·49 ;

W, 45·88 ; Cl, 17·60%). These crystals do not melt upto 350° C. and cannot be sublimed under vacuum and are stable in air and soluble in petroleum ether, diethyl ether but sparingly soluble in benzene, toluene and carbon tetrachloride.

Preparation of Bisindenyl Tungsten Oxydichloride.—To a cold solution of 3·5 g. tungsten oxytetrachloride (0·1 mole) in 100 ml. of tetrahydrofuran was added 5 ml. of indene (0·2 mole) and the contents were refluxed for 12–14 hr. at 95–100° C. The colour of the solution first changed to light red and then pink and finally brown. The solvent was removed by evaporation under reduced pressure and the solid mass after repeated crystallization from ether gave brown crystals of bisindenyl tungsten oxydichloride [Found : C, 43·05 ; H, 2·71 ; W, 36·39 ; Cl, 14·14%. Calc. for $(C_9H_7)_2WOCl_2$: C, 43·11 ; H, 2·79 ; W, 36·50 ; Cl, 14·1%]. These crystals are stable in air for a short period only, melt at 230° C. and sublime at 140–145°/10 mm. These are insoluble in mineral acids and alkalies but soluble in ether, THF and dimethyl formamide. Tungsten was estimated as oxinate and chloride as silver chloride. Infra-red spectra, taken on Perkin Elmer infra cord model 137, is given in Table I.

Infra-red spectra given in Table I indicate that cyclopentadiene and indene react with tungsten oxytetrachloride forming "Sandwich" compounds analogous to other transition metals.[8] On the basis of their analytical data as well as the infra-red spectra, the following structures are suggested for the compounds (I) and (II).



(I) (II)

TABLE I

Infra-red spectra of biscyclopentadienyl tungsten oxydichloride and bisindenyl tungsten oxydichloride

Name of compound	C–H stretching	$(C_5H_5)_2$-metal stretching
$(C_5H_5)_2WOCl_2$(KBr)	3000 cm.$^{-1}$	960, 1110, 1380, 1470, 1640 cm.$^{-1}$
		(C_9H_7)-metal stretching
$(C_9H_7)_2WOCl_2$(Nujol)	3010 cm.$^{-1}$	1460, 1560, 1600, 1660 cm.$^{-1}$

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ANTIGENIC VARIATION IN *VIBRIO CHOLERAE* RESULTING FROM CHROMOSOMAL TRANSFER BY CONJUGATION*

K. BHASKARAN, V. B. SINHA AND S. S. IYER
Central Drug Research Institute, Lucknow, India

THE identification of a fertility system in *Vibrio cholerae* permitted the isolation of genetic recombinants of marked parental strains.[1] Crosses between strains yielded a larger number of recombinants if parental strains were fixed on membrane filters prior to plating on selective media.[2] This technique obviously facilitated cell pairing and effective contact, likely to be less efficient in fluid media because of the active motility of the organism. By this technique it was shown that P^+ strains (possessing the fertility factor P) functioned as gene-donors while P^- strains (devoid of the fertility factor P) served as gene-recipients.

Earlier studies with mutants of *V. cholerae*, strain 162, suggested a chromosomal sequence of seven genetic factors as given below :

str ... pur ilva ... O ... arg ... leu ... his.

As O (symbolising the genetic determinants of O antigen synthesis) was located between ilva and arg, it was expected that when these are used as selective markers a proportion of the recombinants should inherit the contiguous O antigenic determinants as well. Evidence of this is presented here in which Smooth streptomycin-sensitive P^+ (donor) strains

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