Research Note:

RELATIONSHIP BETWEEN SPECIFIC RESISTANCE AND SPECIFIC CONDUCTANCE OF SOILS

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A modification of the saturated soil paste method for the measurement of specific resistance and specific conductance was developed and the relationship between them established, analysing 50 soil samples.

Equipment and Method

Specific resistance was measured with a Beckman Model RC 216 B2 resistance bridge, operated at 1 000 cycles per second, and a Beckman soil cup with a cell constant of 0,25 cm^{-1}.

Specific conductance was measured with a Radiometer conductivity meter type CDM 2d, operated at 3 000 cycles per second, and a Radiometer electrode type CDC 104, with a cell constant of 1,0 cm^{-1}.

(All measurements were done at 20 ± 2°C)

Results

1 *Soil to water ratio*

Soil to water ratio was varied by adding known increments of water to the saturated soil pastes prepared by using 70 g soil of different soils, and the specific resistance measured half an hour later. The results obtained with three different soils are shown in Figure 1. It is evident in each case that a plateau is obtained where increments of water do not affect the specific resistance. Beyond the plateau a dilution effect is found. Adding 6% more water than is required to give a saturated paste will ensure that readings are taken on the plateau and not on the rise before the plateau is reached. Results will consequently be more consistent, but giving slightly higher resistance values and correspondingly slightly lower conductance values for a soil.

2 *Relationships of C to R – modified method (saturated paste plus 6% more water)*

Using the modified method 50 soils were analysed for specific resistance and specific conductance. Conductances were measured on the filtrate of the vacuum filtered paste, which was obtained by adding 6% more water (on mass of water already used) after attaining a saturated paste. Resistances were measured on this paste before vacuum filtering the water for the conductance measurements. (Figure 2)

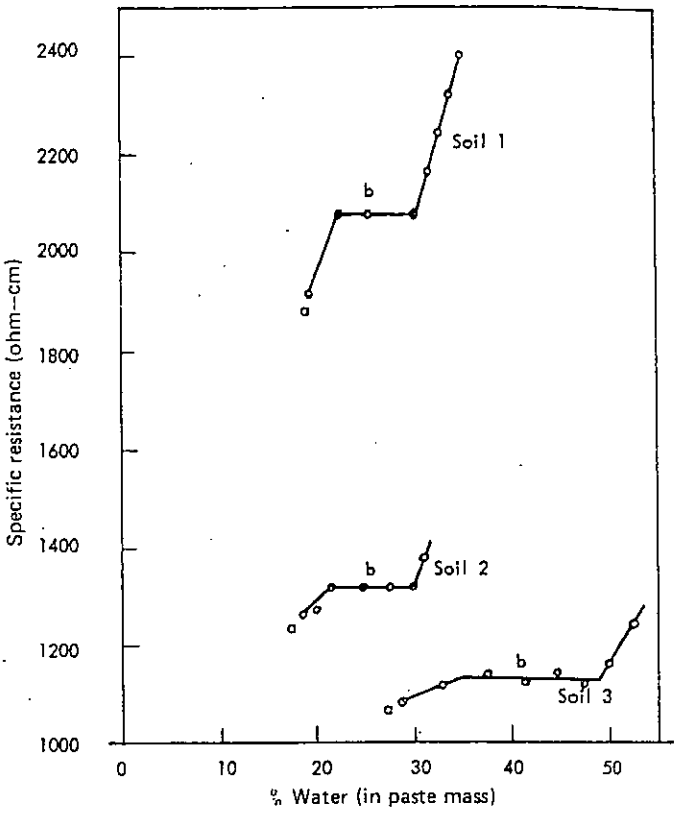

FIG 1 *Effect of water addition to saturated soil paste on specific conductance*
(a = saturated paste)
(b = stabilised plateau)

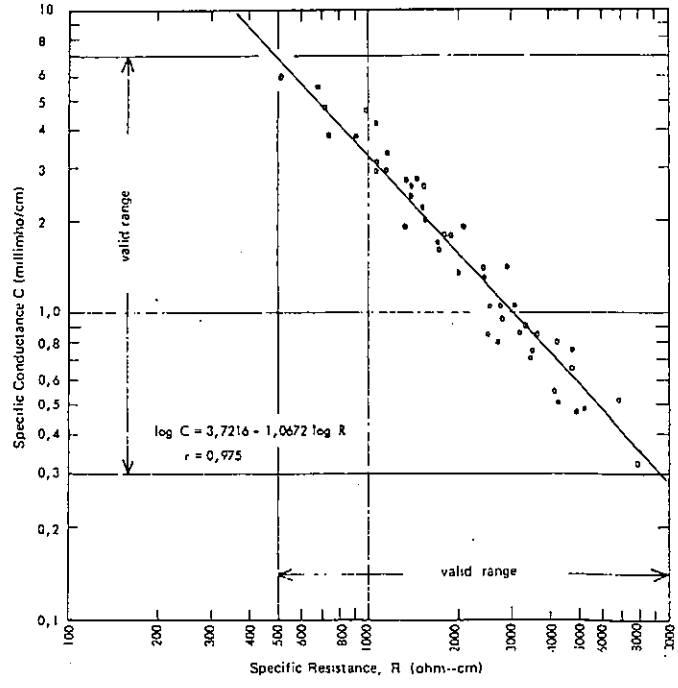

FIG 2 *Relationship between specific resistance and specific conductance of soil, both measured according to a modified saturated paste method (6% more water added)*

The apparent inverse relationship was assumed to be of the type

$$CR^a = K$$

where

C is specific conductance in millimho per cm
R is specific resistance in ohm cm
K is a constant
a is a constant

A logarithmic transformation gives

$$\log C = \log K - a.\log R$$

which means that a linear relationship should be found when plotting the results on log-log sectional paper. The correlation between log C and log R was found to be highly significant with correlation coefficient, r = –0,975, or $100\ r^2 = 95{,}1\%$.

The regression equation was calculated as

$$\log C = 3{,}7216 - 1{,}0672 \log R$$

This gives the following relationship between C and R:

$$CR^{1{,}0672} = 5{,}267 \times 10^3$$

This relationship holds at least for the range R = 500 to R = 10 000 ohm cm and perhaps for R = 300 to 12 000 ohm cm.

Table 1 gives the relationship for convenient conversions.

TABLE 1 *Relationship between specific conductance (C) and specific resistance (R) according to a modified saturated paste method where R is measured on a saturated plus 6% more water and C on the vacuum filtered extract of this 'paste' (calculated from $CR^{1{,}0672} = 5{,}267 \times 10^3$)*

R ohm-cm	C millimho/cm	R ohm-cm	C millimho/cm
300	11,97	4500	0,665
350	10,15	5000	0,594
400	8,81	6000	0,489
450	7,76	7000	0,415
500	6,94	8000	0,360
550	6,27	9000	0,318
600	5,71	10000	0,284
700	4,85	12000	0,234
800	4,20	355	10
900	3,71	392	9
1000	3,31	438	8
1200	2,77	496	7
1400	2,31	573	6
1600	2,01	680	5
1800	1,77	838	4
2000	1,581	1097	3
2500	1,246	1604	2
3000	1,025	3070	1
3500	0,870	5880	0,5
4000	0,754		