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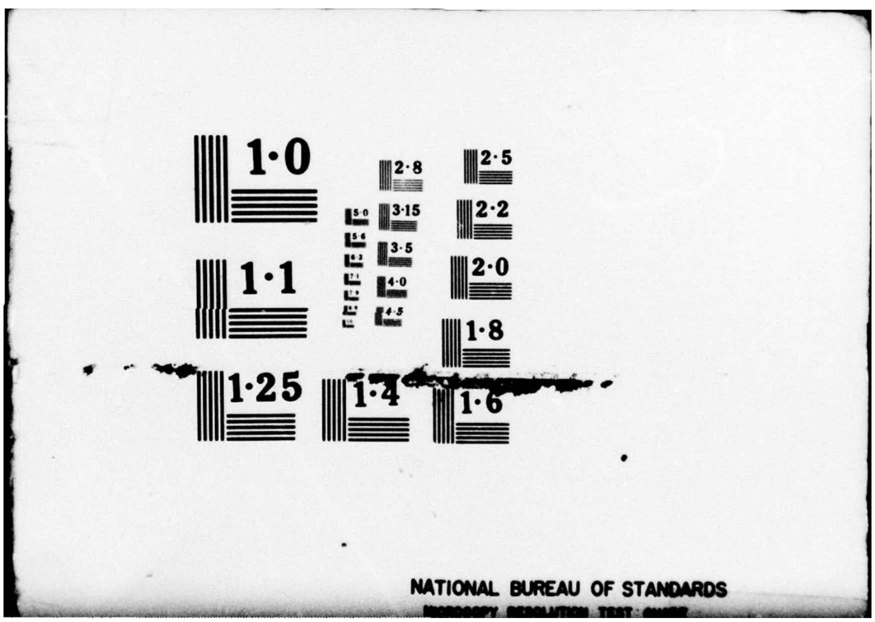
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NEUTRALIZATION OF ORGANIC SUBSTANCES IN WASTE WATER BY PLANTS

April 1978

CORPS OF ENGINEERS, U.S. ARMY
COLD REGIONS RESEARCH AND ENGINEERING LABORATORY
HANOVER, NEW HAMPSHIRE

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This report discusses the neutralization of organic matter in plants using a highly sensitive method of gas chromatography with a flame ionizing detector.

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JOB

NEUTRALIZATION OF ORGANIC SUBSTANCES IN WASTE WATER BY PLANTS

Kupavna OBEZVREZHIVANIYE ORGANICHESKIKH VESHCHESTV STOCHNYKH VOD V RASTENIYAKH in Russian 1975 pp 3-7

The question of the purification of waste water is becoming ever more important in connection with the fast development of the chemical industry. Artificial biological irrigation with the help of water microorganisms is the most widespread method for the purification of waste water contaminated by organic matter. Thanks to the existence of a great variety of microorganisms in the soil, irrigation fields could also be used as a natural method for the biological purification of waste water. Here, along with the protection of water reservoirs from pollution, we resolve the problem of obtaining high crop yields. The danger arises, however, that the organic matter coming from the waste water may accumulate in the plants.

The works of Yu. V. Rakitin at the Institute of Plant Physiology of the USSR Academy of Sciences, as well as a number of other works published domestically and abroad, have proved that, penetrating the plants, herbicides and other phytotoxic substances may disturb one or another metabolic process in the course of which, however, they themselves become detoxified. Only in rare cases do compounds of higher toxicity develop as a result of the toxic substances introduced into the plants through biochemical processes. However, should the plant survive the existence of new toxic substances is only temporary, for, involved in the metabolic processes, they inevitably lose their toxicity.

The VNIISSV (L. Ye. Kutepov and S. I. Khramova) has studied the neutralization of organic matter in the plant using the highly sensitive method of gas chromatography with a flame-ionizing detector.

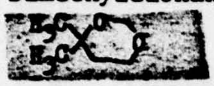
It was determined that plants play an important role in the biological neutralization of organic matter in the utilization of waste water on irrigated fields. The organic substances introduced with the irrigation water were neutralized in the plants, depending on their chemical structure, over different time periods ranging from 1 to 16 days (Table 1). As a rule, the neutralization process in root and tuber crops developed somewhat more slowly than in the above-ground part of the plants. That is why it would be desirable to restrict the use of waste water for irrigation to root and tuber crops.

Aniline, acetone, benzaldehyde, dimethylamine, diethylamine, crotonaldehyde, furfural, cyclohexanol and cyclohexanone were totally neutralized in the plants within a 5-day period; acetaldehyde, benzene, butanol, p-xylene, methanol, n-propanol, toluene, and ethanol were neutralized in 5 to 10 days; caprolactam, dichlorethane, and carbon tetrachloride were neutralized in 10 to 16 days.

In the presence of such organic substances in waste water used for irrigation we must observe the quarantine period between the last watering and the harvest ranging from 2 to 4 weeks depending on the nature of waste water prollution.

Table 1

Name of substance and chemical formula	MPC b.p.s.* mg/liter	Concentration in irrigation water, mg/ℓ	Irrigation norm	Plant type	Period of total decomposition in plant, days
1	2	3	4	5	6
Aniline	0.5	300	50	Corn	1
$C_6H_5NH_2$				Grasses	1
Acetaldehyde	1000	100	100	Corn	8
CH_3CHO				Grasses	8
				Potatoes (tubers)	3
				Potatoes (plants)	4
Acetone	800	300	50	Corn	2
CH_3COCH_3				Grases	2
				Leguminous grasses	2
Benzaldehyde	-	100	100	Corn	3
C_6H_5CHO				Grasses	3
				Potatoes (tubers)	6
Benzene	100	100	70	Corn	5
C_6H_6				Grasses	4
				Carrots (root crop)	6
Butanol	420	100	70	Corn	6
$CH_3(CH_2)_2CH_2OH$				Grasses	3
				Celery (plant)	7
				Celery (root)	8

1	2	3	4	5	6
Dimethylamine $(CH_3)_2NH$	0.7	300	70	Corn	1
				Grasses	1
Dimethyldioxane 	–	500	200	Corn	4
Diethylamine $(C_2H_5)_2NH$	10	300	70	Corn	1
				Grasses	1
Caprolactam 	100	500	200	Corn	16
Crotonaldehyde $CH_3CH{=}CHCHO$	250	100	100	Corn	2
				Grasses	2
				Potatoes (tubers)	5
p-Xylene $C_6H_4(CH_3)_2$	1.0	100	100	Corn	5
				Grasses	4
				Carrots (root crop)	7
Methanol CH_3OH	200	100	70	Corn	2
				Celery (root)	7
				Celery (plant)	3
n-Propanol $CH_3CH_2CH_2OH$	62	100	70	Corn	4
				Grasses	3
				Celery (root)	10
				Celery (plant)	9
Toluene $C_6H_5CH_3$	200	100	70	Corn	5
				Grasses	3
				Carrots (root)	6
Furfural 	1.0	400	50	Corn	2
				Grasses	2
Cyclohexanol $C_6H_{11}OH$	1.0	300	50	Corn	4
				Grasses	3
				Leguminous grasses	3

1	2	3	4	5	6
Cyclohexanone	50	300	50	Corn	5
$C_6H_{11}O$				Grasses	2
				Leguminous grasses	4
Dichlorethane	200	100	50	Grasses	13
$C_2H_4CI_2$				Celery (plant)	8
				Celery (root)	12
Carbon tetra-chloride	50	100	50	Grasses	13
CCI_4				Celery (plant)	16
				Celery (root)	16
Ethanol	—	L))	&)	Corn	5
C_2H_5OH				Grasses	4
				Celery (plant)	5
				Celery (root)	10

*Remark: MPC b.p.s. stands for maximum admissible concentration of matter in artificial biological purification systems.