REMOVAL OF ACETOCHLOR AND METOLACHLOR BY ADSORPTION PROCESS

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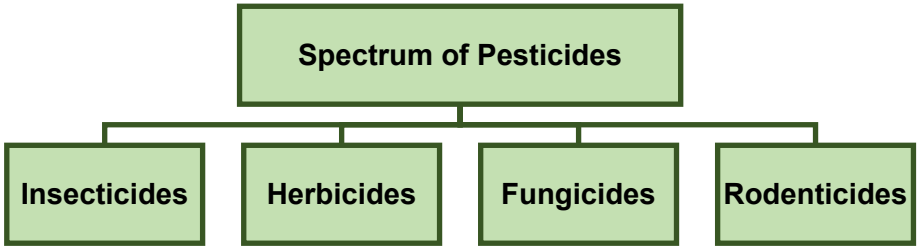
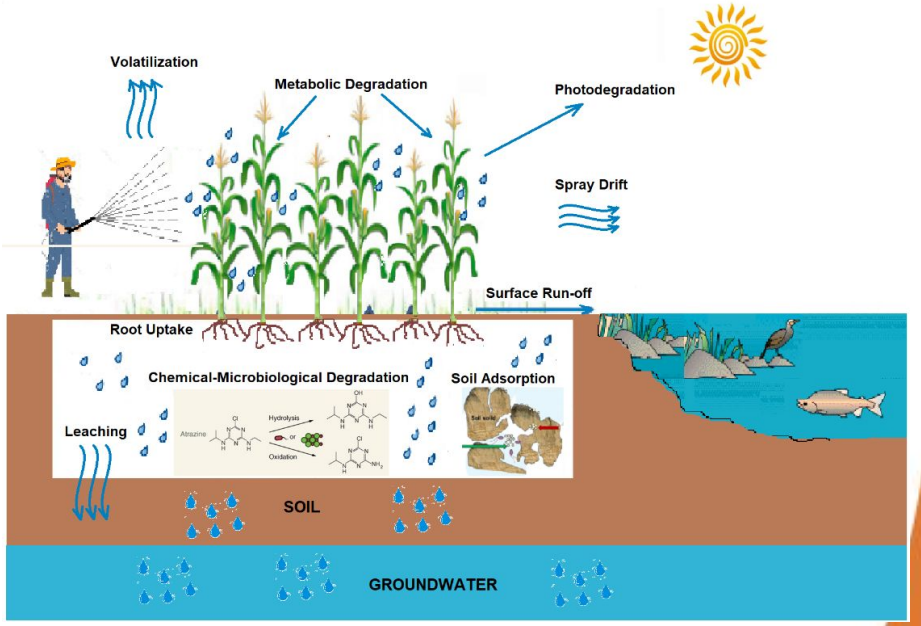
Pesticides

Definition: USEPA defines the pesticides as chemical substances used for controlling and repelling of pests.





Pesticides:

- **carcinogenic, mutagenic, and teratogenic** in nature,
- significantly toxic due to their ability to **bioaccumulate** in organism tissue and migrate to higher organisms.

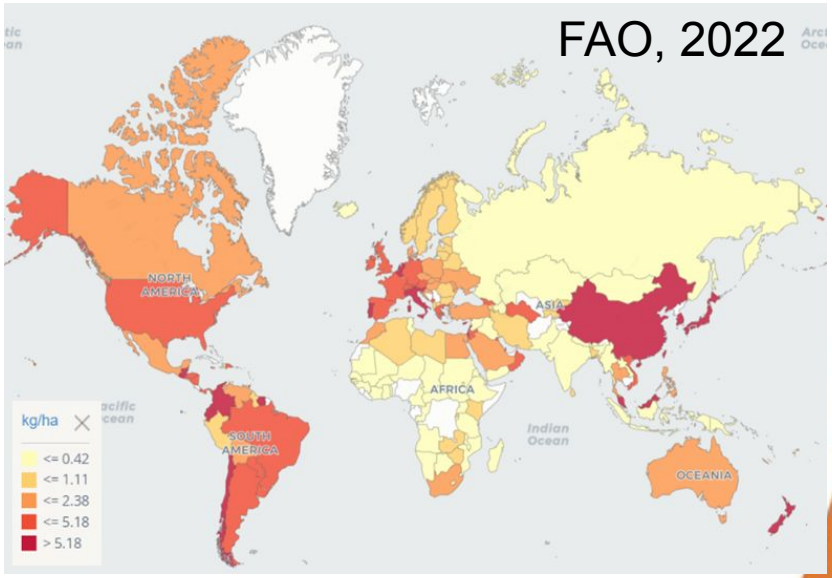
Pesticides Consumption in the World

Pesticides are widely used in:

- Agriculture, industry, forestry, and households.
- Total pesticide use is **4.2 million tons**, and **2.7 kg/ha** of pesticide is applied for cultivated area.

Of the total consumption:

- 47.5% herbicides,
- 29.5% insecticides,
- 17.5% fungicides,
- 5.5% others.



According to the European Commission (EC) database for pesticides, there are **1472 types of pesticides** including active substances, safeners, and synergists and only **453** of which are approved

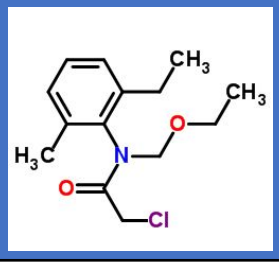
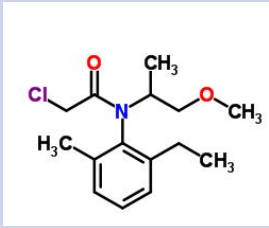
Motivation of The Study

Acetochlor and metolachlor are two pesticides used most frequently and detected at the highest concentration in surface waters worldwide.

Aim of The Study

The aim of this study is to investigate the removal performances of acetochor and metolachlor by adsorption process using of 4 different activated carbon

Material and Methods

Acetochlor	Metolachlor
	

Activated Carbon:

1) AC Puriss,
2) Norit SX F Cat,
3) Norit SX Ultra
4) Norit CA1

Experimental Procedure:

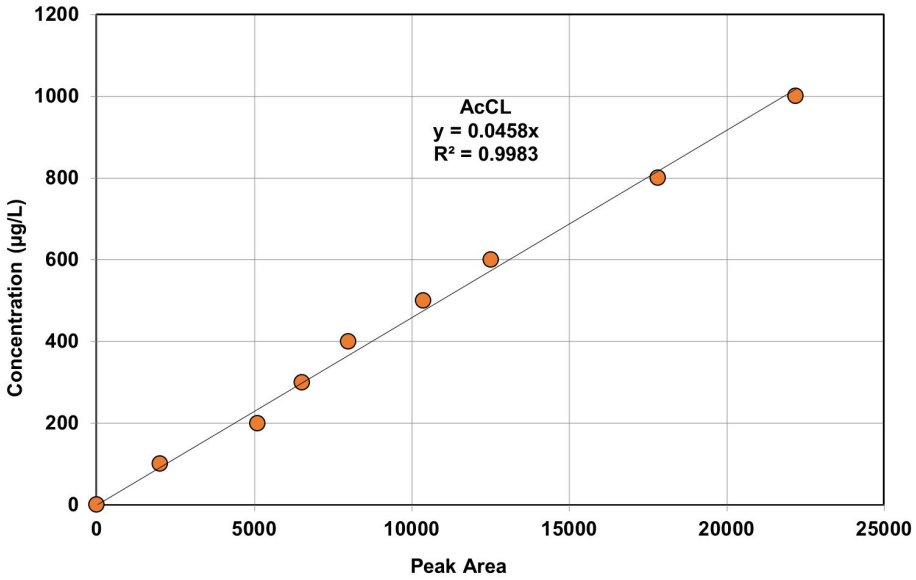
1. Kinetic tests: 2.5 mg/L TOC, 500 µg/L pesticides, 300 mg/L AC, 2-96 hr
2. Isotherm tests: 2.5 mg/L TOC, 500 µg/L pesticides, 10-1000 mg/L AC, 72 hr

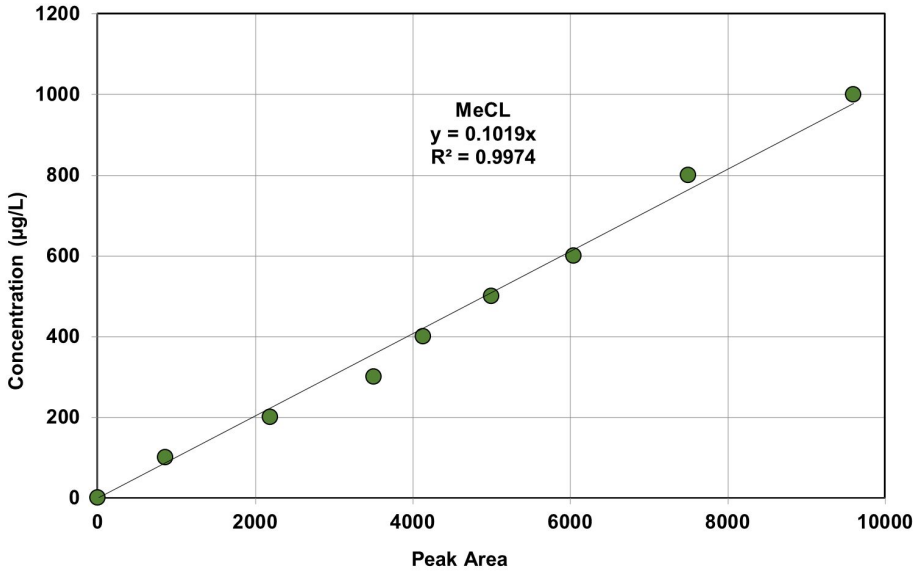
Pesticides Analysis:

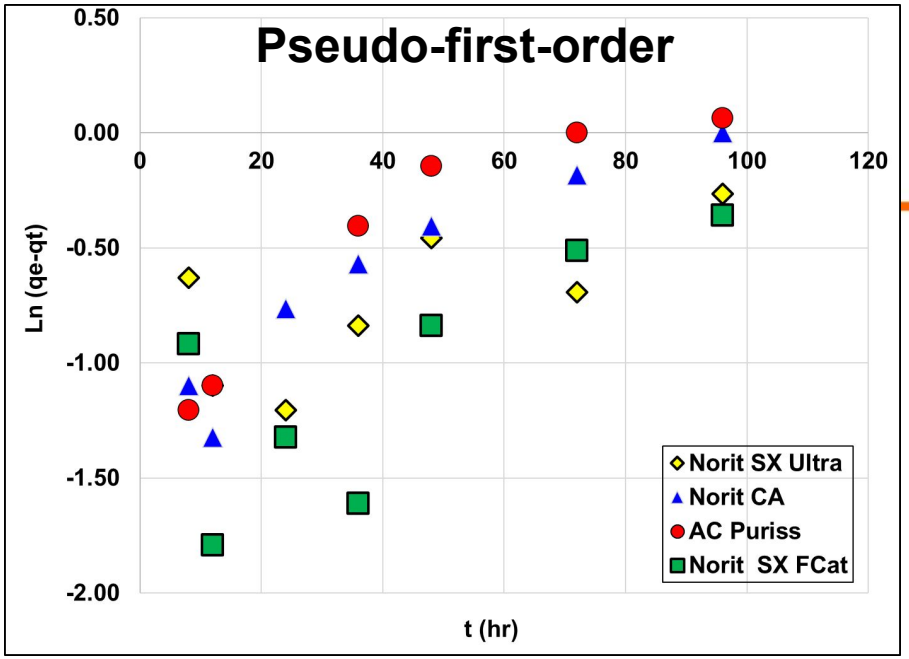
1. Acetochlor: HPLC, DLLME extraction, 70/30 ACN/W, 1 ml/min, 210 nm.
2. Metolachlor: HPLC, DLLME extraction, 80/20 ACN/W, 1.2 ml/min, 230 nm.

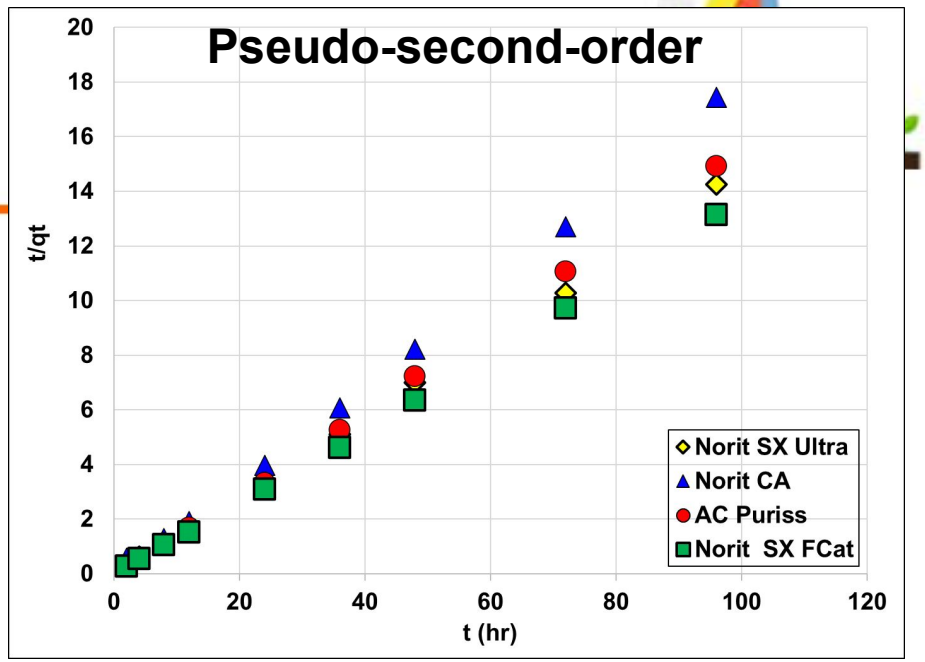
RESULTS

	Flowrate (mL/min)	Oven Temp. (°C)	Solvent Ratio	R^2
Acetochlor	1.00	40	70/30	0.9974
Metalochlor	1.20	50	80/20	0.9983

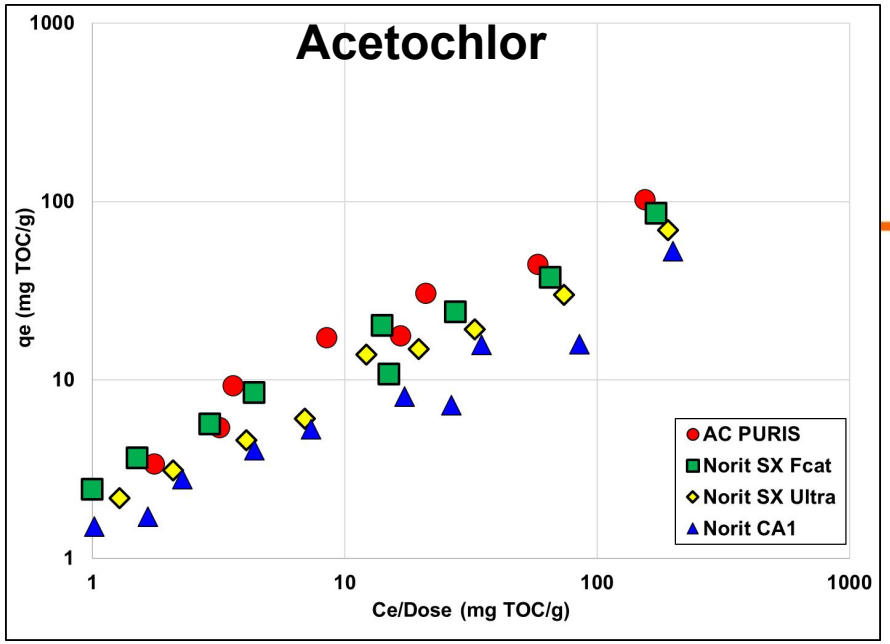


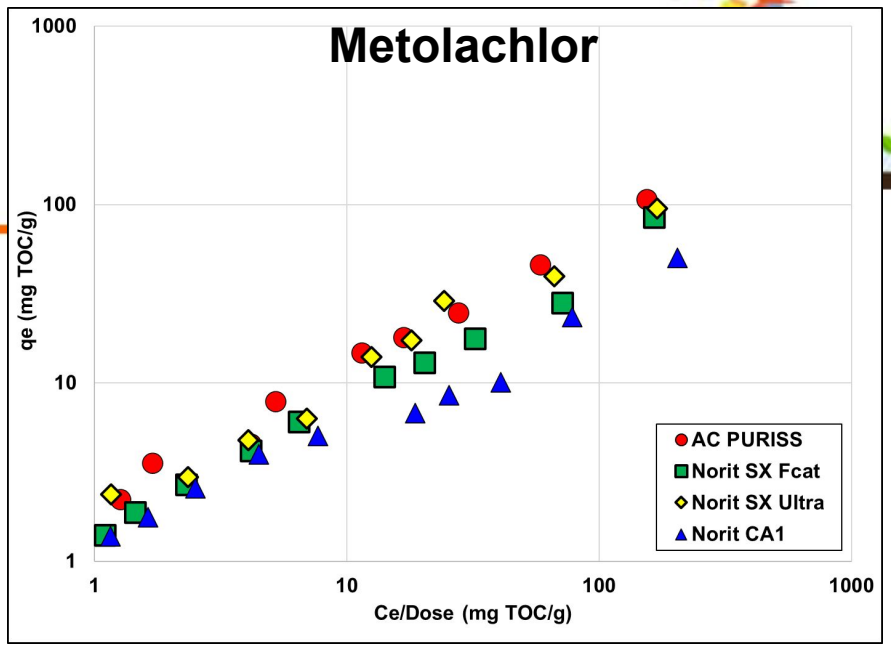






		Pseudo-first-order			Pseudo-second-order		
Adsorbent	**q_e (exp) (mg/g)**	**k_1 (g/mg.h)**	**q_e (cal) (mg/g)**	**R^2**	**k_2 (g/mg.h)**	**q_e (cal) (mg/g)**	**R^2**
Norit SX Ultra	6.87	0.007	2.88	0.47	0.386	6.82	0.99
Norit CA	5.66	0.013	3.13	0.89	0.192	5.55	0.99
AC Puriss	5.52	0.017	3.63	0.79	0.131	6.40	0.99
Norit SX F Cat	7.42	0.013	4.93	0.59	0.198	7.35	0.99

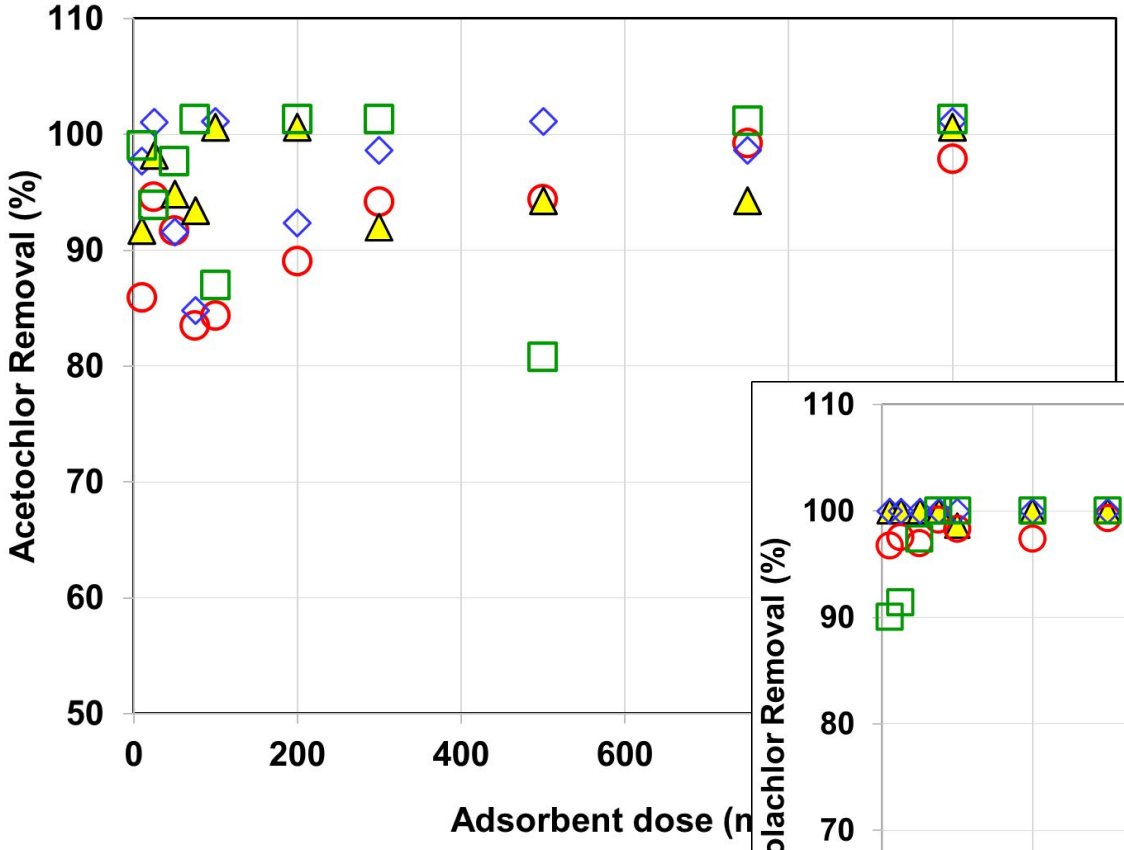


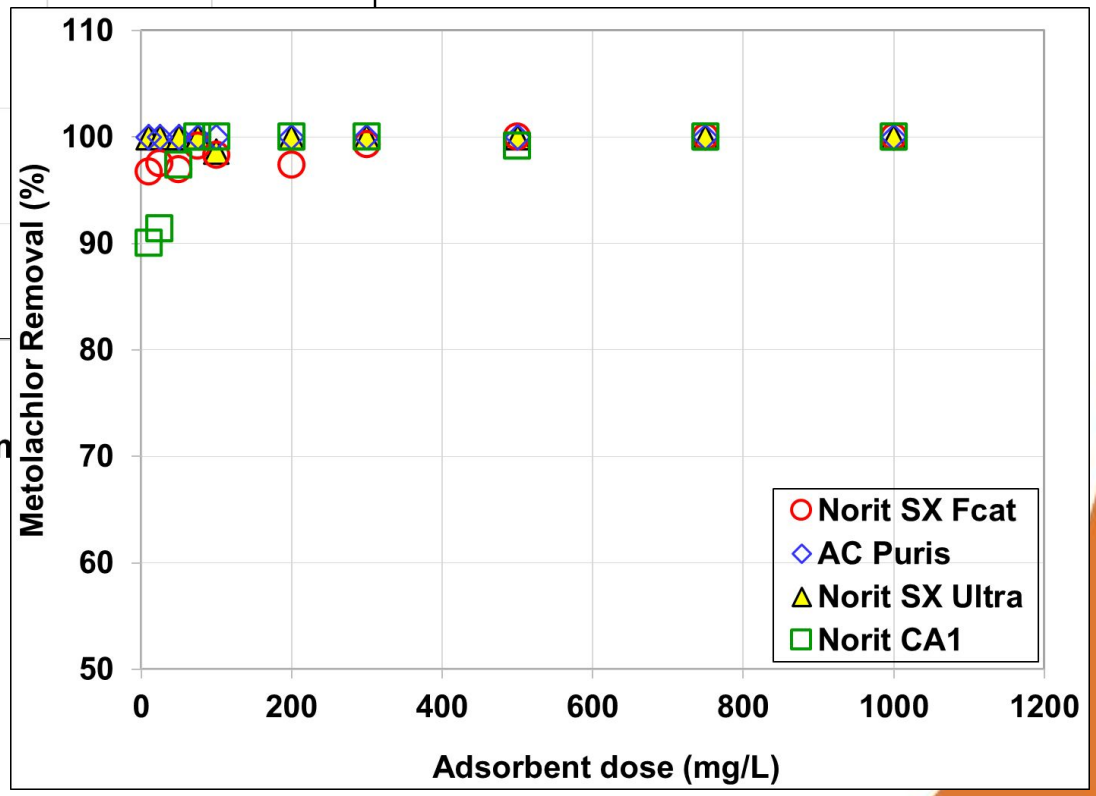


Modified Freundlich isotherm

$$q_e = K_F \left(\frac{C_e}{M}\right)^{1/n}$$

Adsorbent Type	Acetochlor				Metolachlor			
	$q_{e,exp}$ (mg/g)	K_F	n	R^2	$q_{e,exp}$ (mg/g)	K_F	n	R^2
Norit SX F Cat	85.6	2.62	1.5	0.98	84.3	1.36	1.31	0.99
AC Puriss	102.5	2.68	1.37	0.98	106.7	1.91	1.27	0.99
Norit SX Ultra	69.2	1.89	1.48	0.99	95.2	1.82	1.3	0.98
Norit CA1	52.7	1.45	1.63	0.95	50.3	1.28	1.56	0.97


110
100
90
80
70
60
50
Acetochlor Removal (%)
0
200
400
600
Adsorbent dose (n


110
100
90
80
70
60
50
Metolachlor Removal (%)
0
200
400
600
800
1000
1200
Adsorbent dose (mg/L)
Norit SX Fcat
AC Puris
Norit SX Ultra
Norit CA1

SUMMARY

- Adsorbents obeyed the Pseudo second order kinetic rate
- Modified Freundlich Isotherm was applied for adsorption capacity estimation
- AC Puriss provided the highest adsorption capacity:
  - ✔ 102.5 mg/g for acetochlor
  - ✔ 106.7 mg/g for metolachlor
- Acetochlor was removed with > 90% at higher than 200 mg/L adsorbent dosages.
- Metolachlor was almost completely (>99%) removed by all adsorbents even in low dosages.

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Thank you very much for your interests

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