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( / / : / / : )

(TDTMA)

( / / ) pH ( )

(p < / )

pH  
pH

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Mumpton and fishman, )

.(1977

.(Bowman, 2003)

.(Lio and Mayo, 2001)

...

(pH )

BMPs ( Best Management Practices)

-

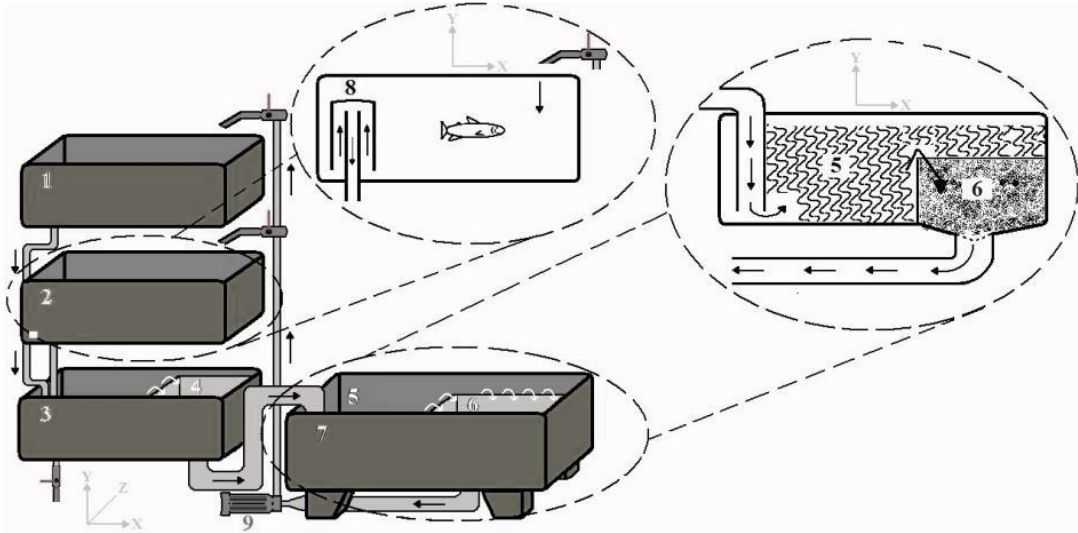
.(Tacon *et al.*, 2003)

-

Macmillian )

.(*et al.*, 2003

( )



( )

Surfactant )

(Modified Zeolite

C

/ / mm

ASTM

Surfactant )

(Modified Bentonite

/

C

rpm

:

C

ASTEM

C

/ / mm

Cl

C

(Surfactant)

/

...

Palintest® 8000

( ± )

N-NO3 mg/L	N-NO3 mg/L	N-NH3 mg/L	°C	%	L/min	mg/L	pH
/ ± /	/ ± /	/ ± /	/ ± /		± /	/	/

/ : ) ) pH

( /

NaOH HCl

pH

Shapiro-Wilk

(Corning 120, Japan)

Levene

XP SPSS 11.5  
Excel

)

( / / )

(

(Palintest® 8000 )

XRD

(SMZ)

(SMB)

(K<sub>d</sub>)

( )

:

( / )

$$K_d = \frac{(C_i - C_e)V}{m}$$

( / ) ( / )

) ( / ) ( / )

(

C<sub>e</sub> C<sub>i</sub>

V (mg/l)

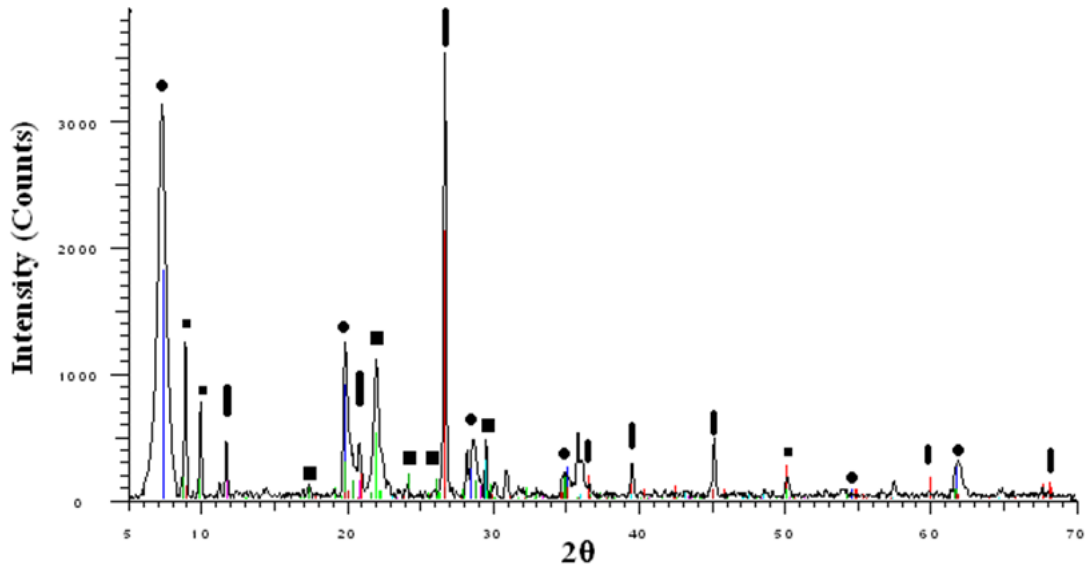
m

XRD

: )

(

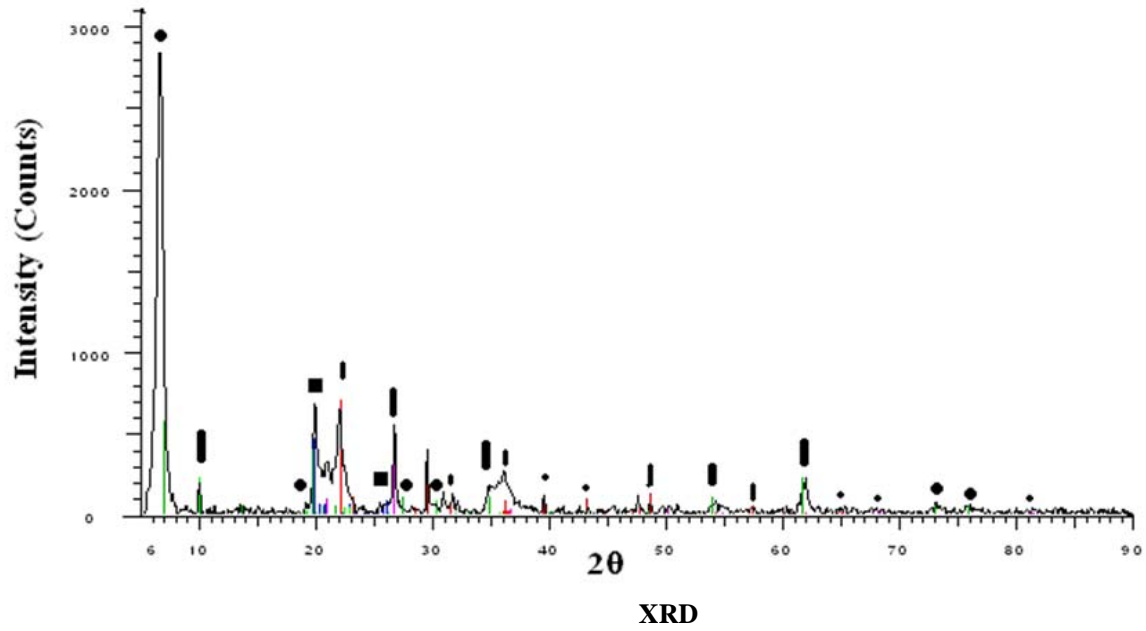
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 ( / ) ( / )  
 ( / ) ( / ) ( / )



XRD

			(%W/W)
█	Quartz, Syn	SiO <sub>2</sub>	/
●	Sodium Calcium Magnesium Aluminum Silicate Hydrate	Na-Ca-Al-Mg-Si-O-H <sub>2</sub> O	/
■	Stellerite (Na)	Na <sub>2</sub> (Al <sub>2</sub> Si <sub>7</sub> )O <sub>18</sub> ·7H <sub>2</sub> O	/
█	Gypsum, syn	CaSO <sub>4</sub> ·2H <sub>2</sub> O	/
■	Illite-1 ITM RG, ammonia	[(NH <sub>4</sub> ),K](Si,Al) <sub>4</sub> Al <sub>2</sub> O <sub>10</sub> (OH) <sub>2</sub>	/
■	Muscovite 2M1, syn	KAl <sub>2</sub> Si <sub>3</sub> AlO <sub>10</sub> (OH) <sub>2</sub>	/
█	Quartz, syn	SiO <sub>2</sub>	/

...



			(%W/W)
█	Cristobalite, syn	SiO <sub>2</sub>	/
■	Aluminum Sulfate Hydrate	Al <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub> ·16H <sub>2</sub> O	/
●	Heulandite	Ca(Al <sub>2</sub> Si <sub>7</sub> O <sub>18</sub> )·6H <sub>2</sub> O	/
▬	Quartz, syn	SiO <sub>2</sub>	/
▬	Montmorillonite	Na <sub>x</sub> (Al,Mg) <sub>2</sub> Si <sub>4</sub> O <sub>10</sub> (OH) <sub>2</sub> ·zH <sub>2</sub> O	/
•	Calcite	CaCO <sub>3</sub>	/

XRD

X-R Diffractometer, D8ADVANCE, ) XRD

(Germany

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( / ) ( / )

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(p< / )

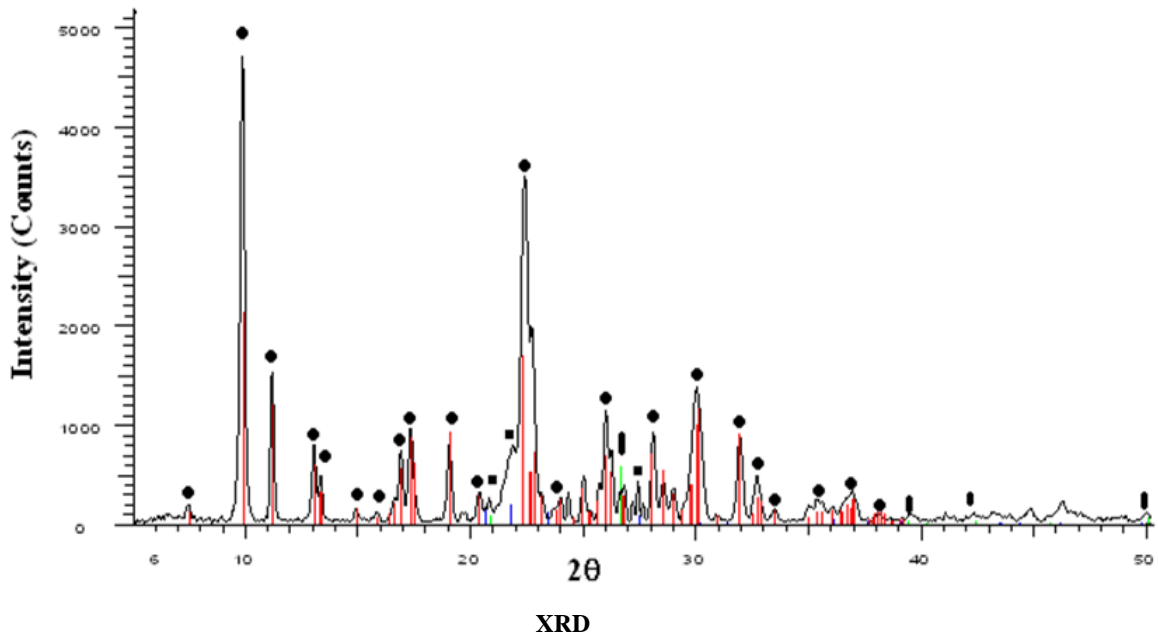
(p< / )

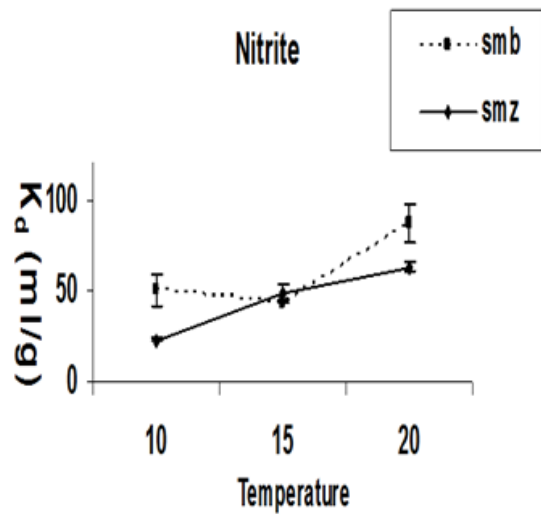
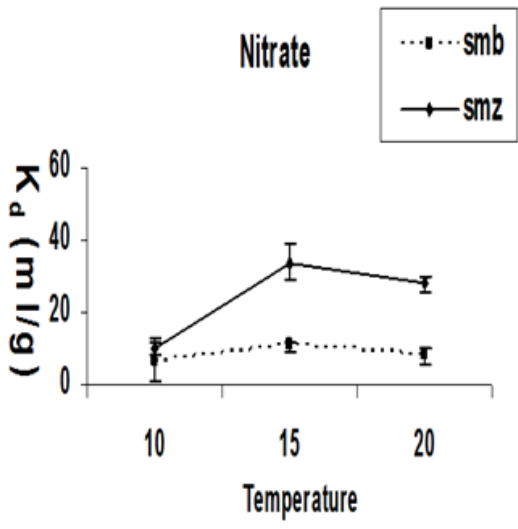
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pH

(p< / )

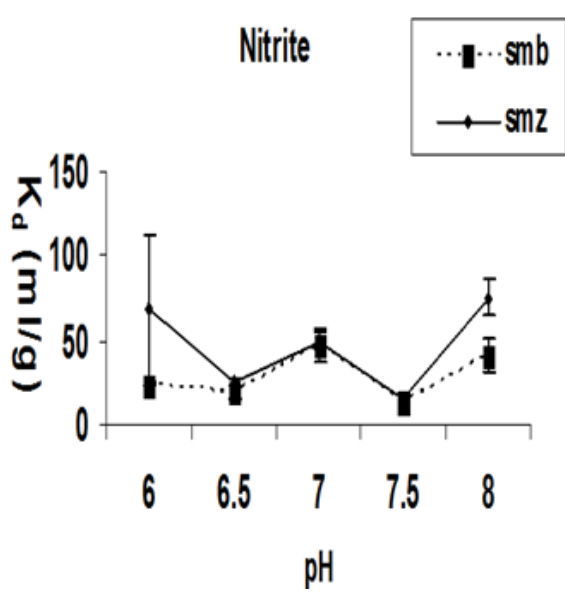
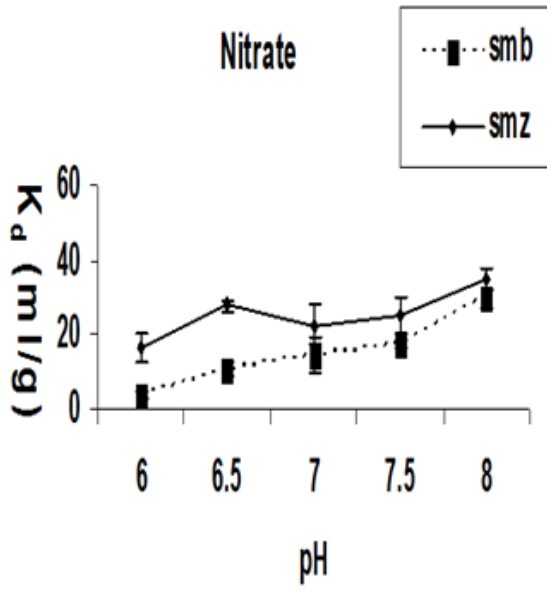
pH





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pH



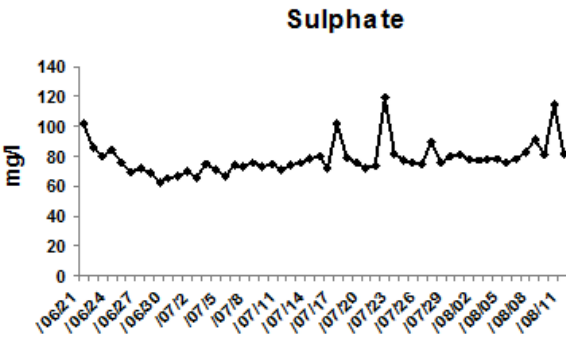
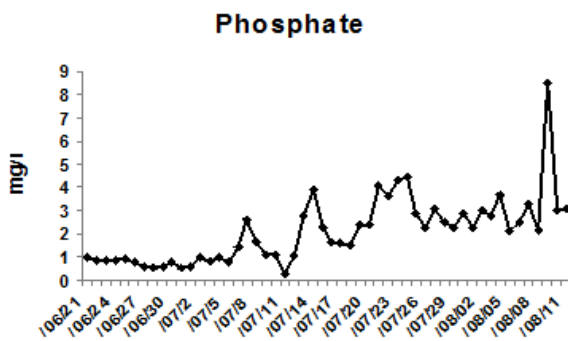
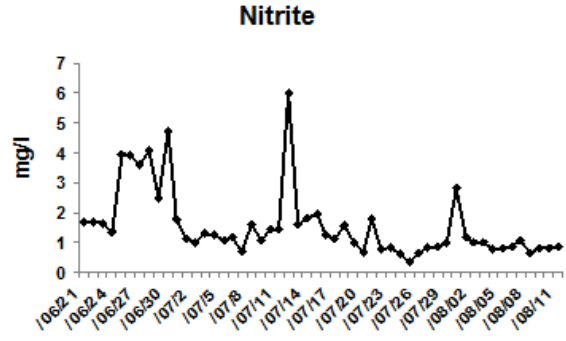
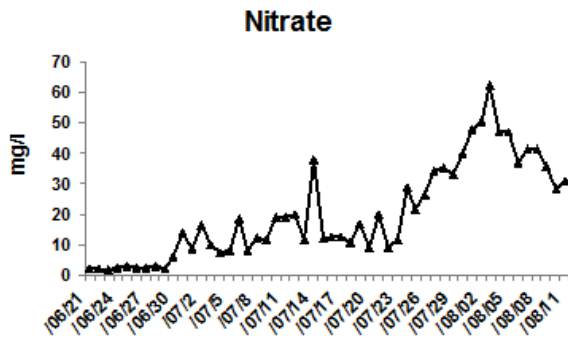


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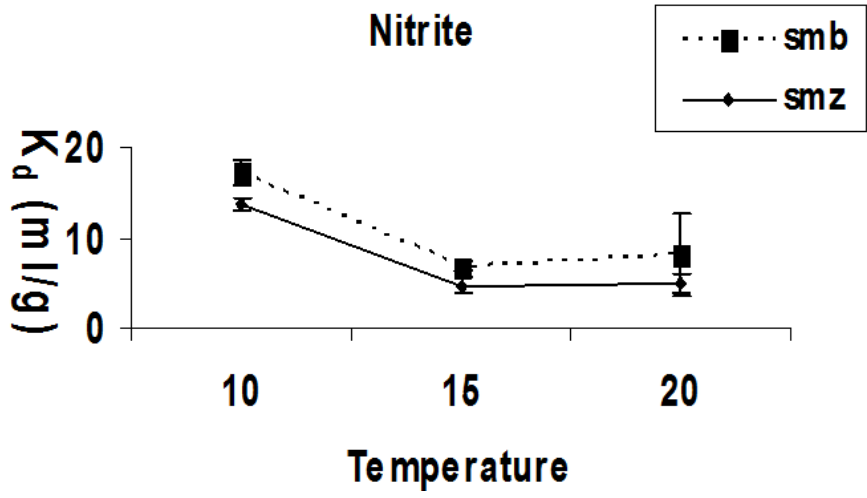
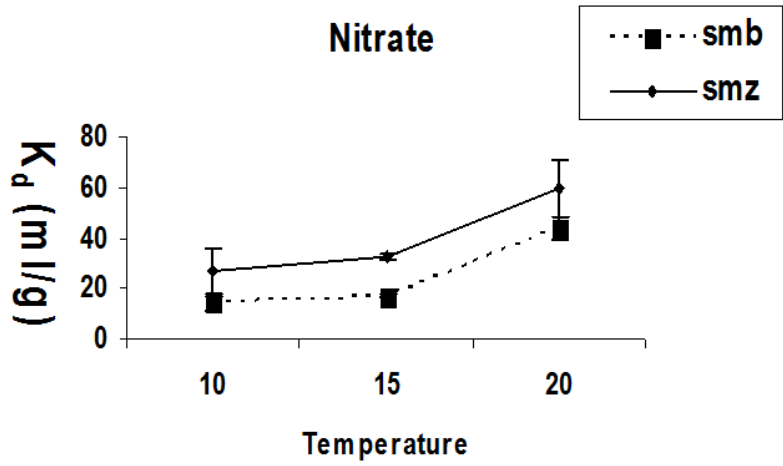
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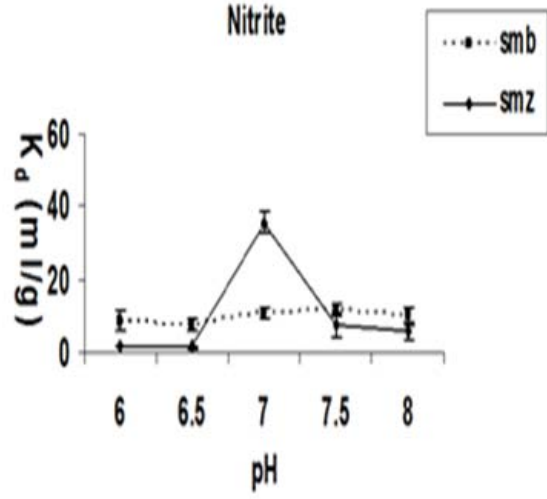
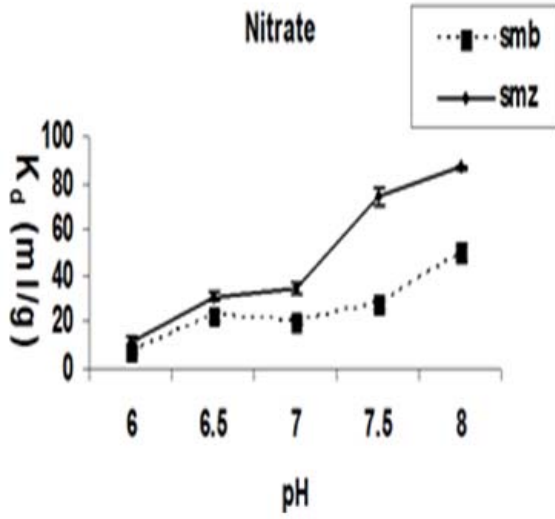


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(*et al.*, 2004; *Zhu et al.*, 2009

pH

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pH

(*Riebe et al.*, 2005)

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pH

pH

.(Gok *et al.*, 2008; )

.(Riebe and Bunneberg, 2007)

(Riebe  
*et al.*, 2005; Riebe and Bunnenberg, 2007;  
.Behnsen and Riebe, 2008; )

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## Recirculation aquaculture effluent treatment by using Clinoptilolite and Bentonite modified by cationic surfactant

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### Abstract

Nitrogenous compounds are the main anionic pollutants in recirculating aquaculture systems. Ion exchangers are widely applied in waste water industry. Negative surface charge of the zeolites and clays enable them for cation absorptions, however, they do not have any tendency for absorbing anion absorptions. Meanwhile, by modifying surface structure, they can absorb anions. In the present study, modifications of superficial and layered structures of clays were carried out using the organic compound, tetradecyltrimethylammonium and heat treatment to enable the ion exchangers to absorb the nitrogenous anions from rearing system. Three different ambient temperatures (10, 15 and 20 °C) and different pHs (6, 6.5, 7, 7.5 and 8) were used. Results showed that environmental conditions influenced anionic adsorption. Nitrate and nitrite adsorption from aquaculture effluent and nitrate from standard solution by two adsorbent had significant effect by ambient temperature ( $P < 0.05$ ). In aquaculture effluent, pH did not show any regular effect on nitrite adsorption. It was inferred that environmental factors such as temperature, pH, anion concentration, presence of other ions and counter ions are effective on absorptive capability of a given ion. Results showed that modified ion exchangers might be useful for harmful anion adsorption from recirculating aquaculture system.

**Keywords:** Reticulation system, Nitrogenous compounds, Bentonite, Zeolite, Surfactant, Anion adsorption