

# PHOSPHORUS



**EiMAS**  
**Institut Alam Sekitar Malaysia**  
*Environment Institute of Malaysia*



# Take Home Messages

- ◆ Phosphorus is a nutrient, essential to growth.
- ◆ Phosphorus can occur as orthophosphate, condensed phosphate, or organic phosphate.
  - The optimal test method depends on the form in which phosphorus is present.



# Why is Phosphorus Important?

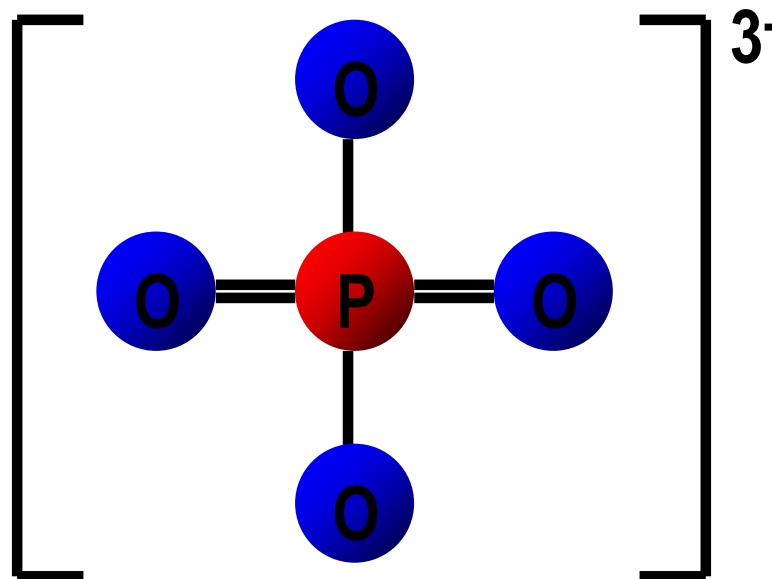
- ◆ Essential to the growth of organisms
- ◆ Limiting factor for photosynthesis
- ◆ Excess quantities can cause eutrophication
- ◆ Phosphorus occurs in natural waters and wastewaters primarily in the form of **phosphates**.





# How does Phosphorus Occur?

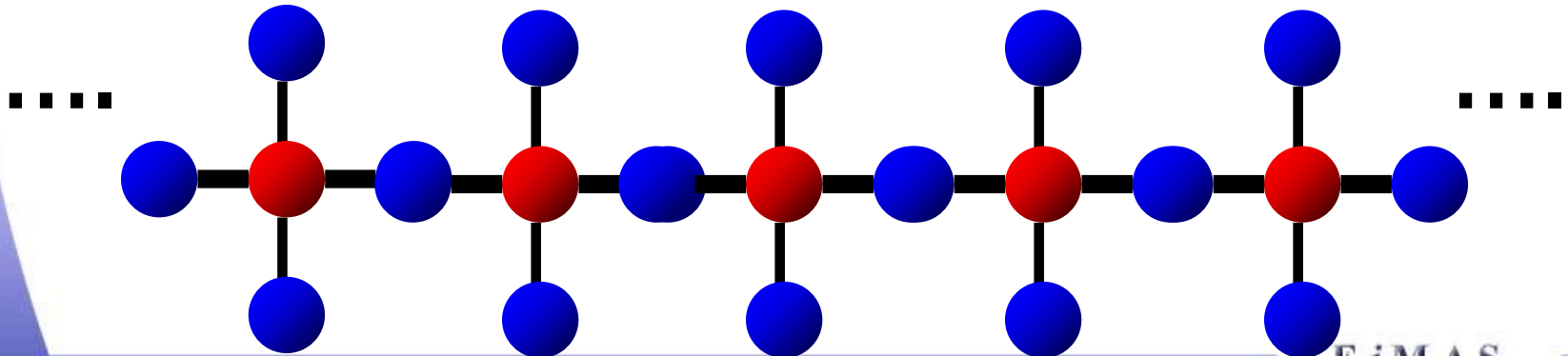
- ◆ Phosphate ion is also known by the names:
  - Orthophosphate
  - Reactive phosphate





# How does Phosphorus Occur?

- ◆ Condensed phosphate
  - Metaphosphate
  - polyphosphate
  - pyrophosphate





# Where are Orthophosphates Found?

- ◆ Fertilizers for agricultural or domestic use
  - Phosphates are carried into surface waters by storm runoff and melting snow.
- ◆ Reactive phosphorus (or orthophosphate) is the only form of phosphate that is determined directly.
  - Condensed and organic phosphate must be pretreated before orthophosphate analysis.



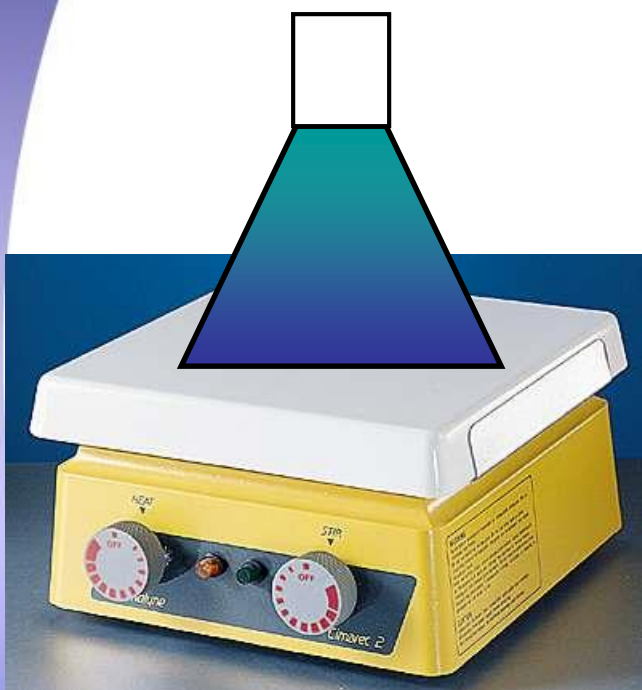
# Orthophosphates & total phosphorus.

- ◆ Orthophosphates are readily measured by colorimeter.
- ◆ Complex phosphates i.e. condensed phosphates are to be converted to orthophosphates, for total phosphorus analysis.



# Analysis of Condensed Phosphates

## ◆ Step 1 – Acid Hydrolyzable Digestion



- Boil the 25 ml sample with 2 ml 5.25N  $\text{H}_2\text{SO}_4$  for 30 minutes to break the condensed phosphate chains into orthophosphate
- This can be performed using a hot plate or Test N Tubes





# Analysis of Condensed Phosphates

## ◆ Step 2 – Neutralization

- Neutralize the digested sample with hydroxide and perform the most suitable orthophosphate test on the neutralized sample.





# Analysis of Condensed Phosphates

## ◆ Step 3 – Undigested Portion of Sample

- Perform an orthophosphate test on an undigested portion of sample.





# Analysis of Condensed Phosphates

## ◆ Step 4 – Final Results

- Subtract the orthophosphate results from the undigested sample from those of the digested sample.
- Difference = amount of condensed phosphate in sample

**Digested – Undigested  
= mg/L Condensed  
Phosphate**



# Digestion Options

- Hot plate
- Hach's COD Reactor





## Phosphorus – Take Home Messages

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- ◆ Phosphorus can occur as orthophosphate, condensed phosphate, or organic phosphate.
  - ✦ The optimal test method depends on the form in which phosphorus is present.

# PHOSPHORUS

The End.



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