# Archaea's role in wastewater treatment plants

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## Introduction

Wastewater treatment plants (WWTP) reduce organic content of wastewater, remove toxic compounds and inactive microorganisms and parasites[1]. Activated sludge and biofilm-based technologies are analysed to know the diversity of archaea and which roles do they have in them[1,2].

## What do we expect to find?

### Methanogenic archaea

Microorganisms belonging to *Euryarchaeota* phylum and produce methane by three pathways:

- **Hydrogenotrophic** → reducing $CO_2$
- **Methylotrophic** → using methyl-groups containing compounds
- **Acetoclastic** → using acetate

They are classified in ***Methanobacteriales***, ***Methanococcales***, ***Methanomicrobiales***, ***Methanosarcinales***, and ***Methanopyrales***[3].

### Ammonia-oxidising archaea

Microorganisms belonging to *Thaumarchaeota* phylum and participate in ammonia oxidation to nitrite[4].

### Biofilms

They will be found in granules (biofilm-based system), they are formed by archaea and bacteria[2]. Biofilms are also formed in membrane bioreactors (MBR), causing biofouling[5].

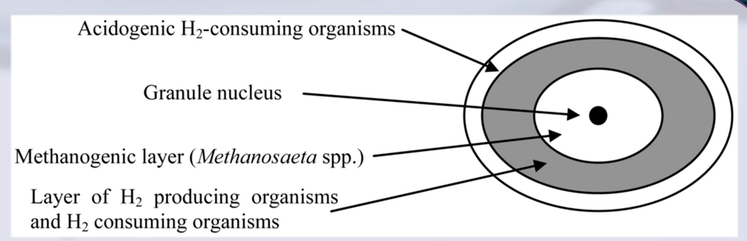


**Figure 1.** Layered structure of a granule[2].
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## Most relevant results

### Diversity in activated sludge

The most represented sequence is *Methanosaeta* spp. It is suggested that ARC I and *M. concilii* compete for acetate[6].

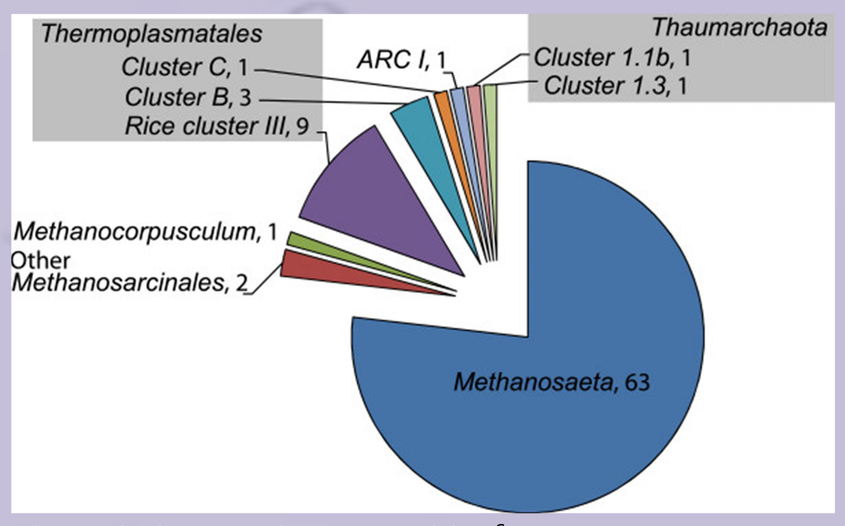


**Figure 2.** Community composition[6].
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### Diversity in biofilm-based digestors

Methanogens are the main population. The most common hydrogenotrophic methanogens are *M. thermoautotrophicus* and *Methanoculleus thermophilicum*. The most common acetoclastic methanogens include *Methanosarcina thermophila* and thermophilic *Methanosaeta*[2].

### Ammonia-oxidising archaea (AOA)

AOA occur in alternation of aeration conditions, with low DO and long solids and hydric retention times[7].

### Distribution

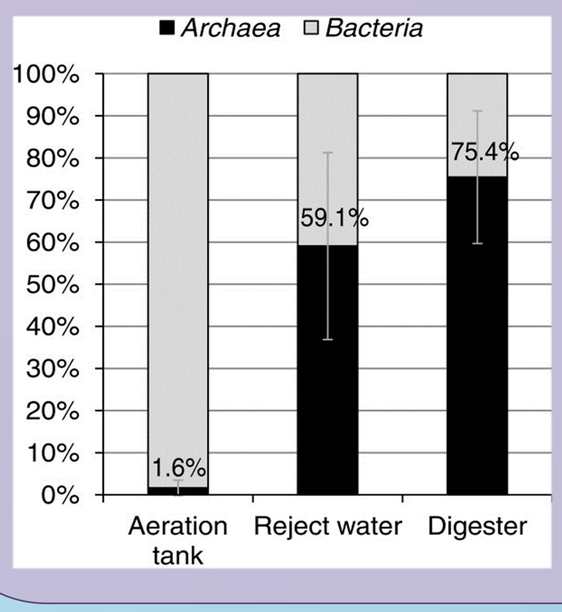


**Figure 3.** Quantification of Archaea[6].
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### Factors affecting diversity

- Temperature
- Dissolved oxygen concentration (DO)
- Chemical composition of water[2]

### Biofouling

The prevalent populations are related to *Methanospirillaceae* and *Methanosaeta* spp.

## Conclusions and future persectives

- There are still lots of challenges:
  - Why methanogens are so common in WWTP
  - Survival skills
  - Contribution to biofilms
- AOA must be studied by their activity, not the presence of the gene *amoA*
- Abundance does not give information about roles, as activity is not always related to quantity.
- *Methanosaeta* is the most common species in both types of WWTP
- Inhibition of quorum sensing may help fighting biofouling

## State of art

### Diversity

Methanogens maintain their populations in activated sludge despite of environmental changes, they tolerate oxygen[6]. In biofilm-based systems there is always an acetoclastic and a hydrogenotrophic, but species vary between digesters[8]. AOA's activity generates controversy, many authors disagree in which is AOA's role[7].

**Abundance:** It is estimated to be low, between 8-10%[6].

**Distribution:** It depends on the type of WWTP, not on the nature of water[8].

**Biofouling:** New strategies must be studied to fight against it.

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