Summary
The predominant bacteria in activated sludge are responsible for the degradation of organic and inorganic compounds. The bacteria derive their nutritional requirement from the compounds presented to them in the influent waste.

Removal of heavy metals from contaminated sites using microorganisms is a promising alternative to the chemical and physical technologies. In this study, the bacterial strains isolated from Sewage Disposal Station of Beyahmo, (Fayoum - Egypt), were identified as *Micrococcus halobius*, *Streptococcus mutans*, *Aureobacterium barkeri*, *Bacillus cereus* and *Bacillus globisporus*, based on their morphological (cell shape and endospore formation), physiological (salinity, pH and temperature) and biochemical characterization (catalase, amylase and urease activities), as well as the type of carbon source.

The isolates from this study showed a metal tolerance profile against mercury (*B. cereus* and *B. globisporus*), cadmium (*S. mutans* and *A. barkeri*) and lead (*M. halobius* and *A. barkeri*).

The isolates (*M. halobius*, *S. mutans*, *A. barkeri*, *B. cereus* and *B. globisporus*) also demonstrated a high capability for chelation of various concentration of some metals achieved with off-gases from the culture of the isolates.
The rate of Cd bio-precipitation using outlet gases from each strain or strains mixture was found to be 99% in the case of mixture and 95% in the case of *A. barkeri*).

The results of exposure time on the bio-precipitation rate of monospecies metal solutions using outlet gases from the activated sludge indicated that metal precipitation was achieved after 24 hrs of exposure. The recorded percentage of removal obtained were 99.5% for lead, 99.7% for cadmium, 97.6% for mercury, 99.2% for iron, 98.4% for manganese, 98.1% for cobalt, 80.3% for nickel and 97.9% for zinc.

The results of bio-precipitation of metals from various concentrations of their solutions using biogas produced during the aerobic growth of the activated sludge from raw domestic wastewater indicated potential removal of Pb$^{2+}$, Fe$^{2+}$, Hg$^{2+}$, Mn$^{2+}$ and Cd$^{2+}$ was achieved within 24 hours of exposure time. The rate of lead bio-precipitation was 93.4%, 98.9% and 99.4% when initial concentrations 6.1, 75.1 & 315.7 mg/l were used. The recorded rates of iron removal were 98.1%, 99.0% and 99.9% when initial concentrations 5.3, 20.7 and 219.6 mg/l were used while the mercury removal was 84.4%, 98.4% and 98.9%.

While the recorded bio-removal rates for manganese were 93.5%, 99.4% and 99.9% with initial concentrations 3.1, 32.7 and
173.1 mg/l respectively, the recorded rates for cadmium were 96.9%, 99.6% and 98.4% with initial concentrations of 9.8, 25.7 and 112.1 mg/l respectively.

By studying the Bioprecipitation of metals from a mixed metals solution using the biogas produced from the mixed population of the activated sludge sample after 24 hours of exposure time, we found that some metals were highly precipitated as iron III (100%), lead II (99.0%), manganese II (98.8%), cobalt II (97.6%) and nickel II (94.2%) within 24 hrs of exposure time. Another group of metal ions zinc II, mercury II and cadmium II were precipitated efficiently from the mixed solution as well. The recorded percentage of metal removal was 85.3% for zinc II, 81.6% for mercury II and 80.9% for cadmium II with the same exposure time. Obviously, the lowest rate of metals removal was recorded for copper II (60.1%) after 24 hrs exposure time.

In this study by using the Fourier Transform Infrared Spectrophotometer (FTIR) analysis of the metal precipitates we can identified some sulfur groups such as disulfide group (at 540 cm\(^{-1}\)) and sulfhydryl group (at 2550 cm\(^{-1}\)) that was attributed to the presence of some volatile sulphur species in the bacterial biogas.

The results of this study have attributed the great tendency of the bacterial biogas for metal bioprecipitation to the presence of
volatile sulfur compounds that play the major role in the transformation of soluble metal ions into insoluble metal complexes.

Also the IR analysis of the metal precipitates showed the presence of amine groups (at 800 cm\(^{-1}\)) and thiocarbonyl groups.