International Interdisciplinary Congress on Renewable Energies, Industrial Maintenance, Mechatronics and Informatics
Booklets

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Title: Staphylococcus carnosus. Study as an alternativo biocollector for metal minerals

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Editorial label ECORFAN: 607-8695
BCIERMMI Control Number: 2022-01
BCIERMMI Classification (2022): 261022-0001

Pages: 13
RNA: 03-2010-032610115700-14

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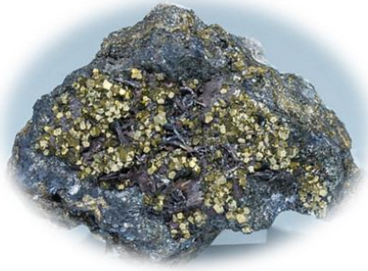
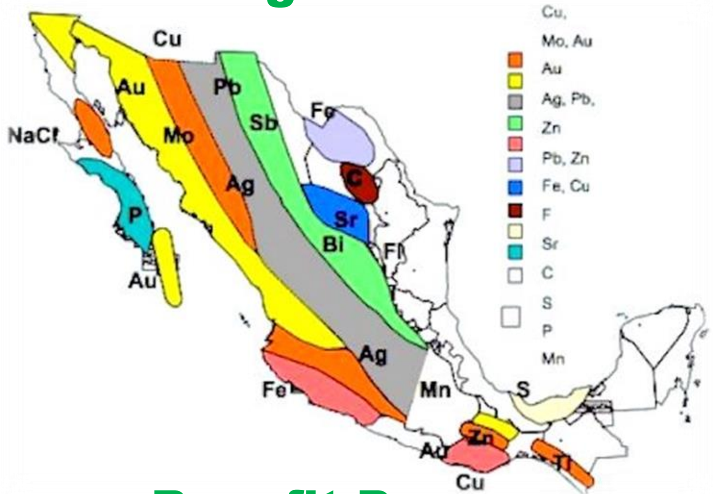
Introduction

Chalcopyrite+ Pyrite

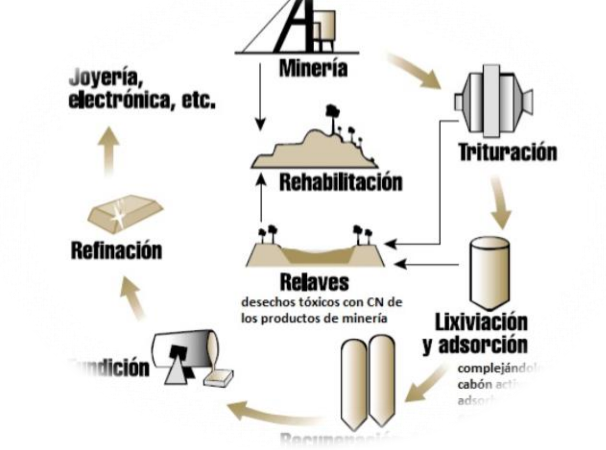


Galene + Pyrite

Mining in Mexico



Benefit Process



Mining Legislation

Environmental Mining Economy

Introduction

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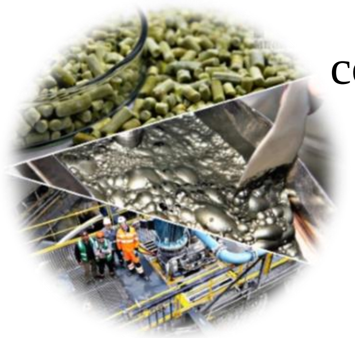
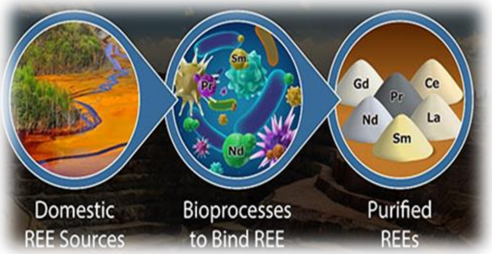
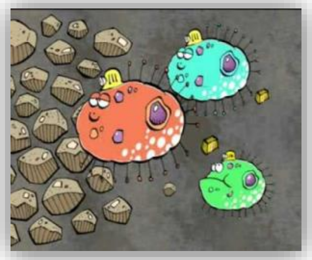
Traditional Process



conventional reagents most used in mining
Xanthate

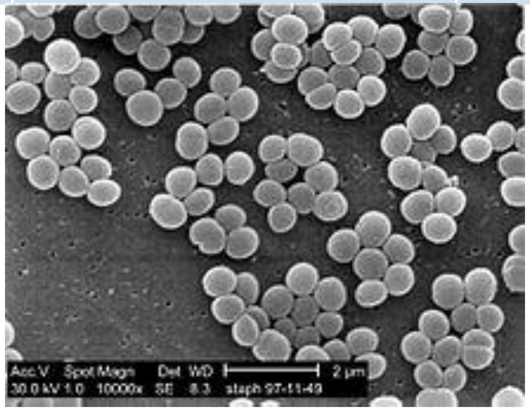
Biomining





Author	Year	Bacteria	Mineral Studied
Ramos –Escobedo et al	2002	Acidithiobacillus ferrooxidans	Sphalerite and chalcopyrite
Nagaoka *et al*., 1999,;	1999	Leptospirillum ferrooxidans,	
Subrahmalannian *et al*., 2003,	2003	Polymyxa Paenibacillus,	
Pecina *et al*., 2009	2009	Acidithiobacillus thiooxidans	
Santhiya *et al*	2001 2002	Acidithiobacillus thiooxidans, Acidithiobacillus ferrooxidans	Sphalerite (ZnS)-galena (PbS). Sphalerite . pyrite and arsenopyrite
Ramos-Escobedo et al	2016	Staphylococcus carnosus	Coal

Staphylococcus carnosus



Methodology

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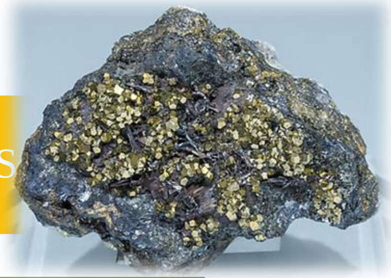
STUDIO MINERALS



MINERAL CHARACTERIZATION

BACTERIA PREPARATION

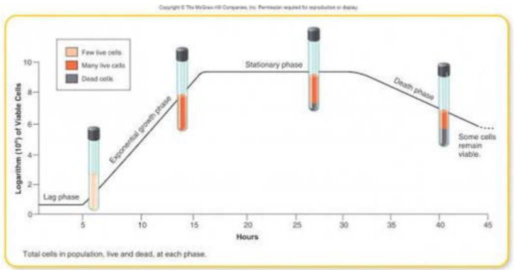
PHYSICAL TEST

CHEMICAL TEST

GROWTH CURVE

AREA

ANALYSIS



Methodology

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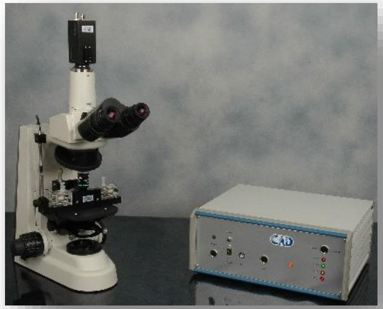
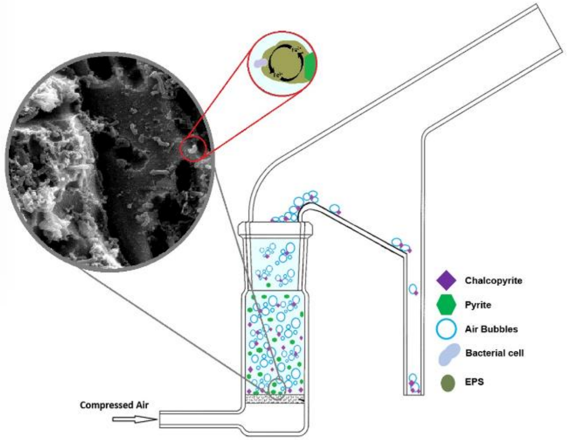
PREPARATION OF MINERAL WITH BACTERIA.

BIOMINING

- BACTERIAL ADHESION WITH MINERAL.
- ZETA POTENTIAL
- MICROFLOTATION





Results

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Table 1. Chemical analysis of minerals

Minerals	Fórmula	Cu%	Zn%	Fe%	S%	Pb%	Purity %
Chalcopyrite	$CuFeS_2$	31.24	0.22	32.58	30.45	0.01	90
Galena(+)	PbS	0.009	0.157	0.135	12.39	73.01	85
Pyrite(+)	FeS_2	0.002	0.004	40.42	47.439	0.006	88
(+) Associated gangue silicates.							

Table 2. Surface area of the mineral fraction used.

Minerals	*Surface area, m^2/g*
Chalcopyrite	*0.0109*
Pyrite	*0.00874*
Galena	*0.00673*

Results

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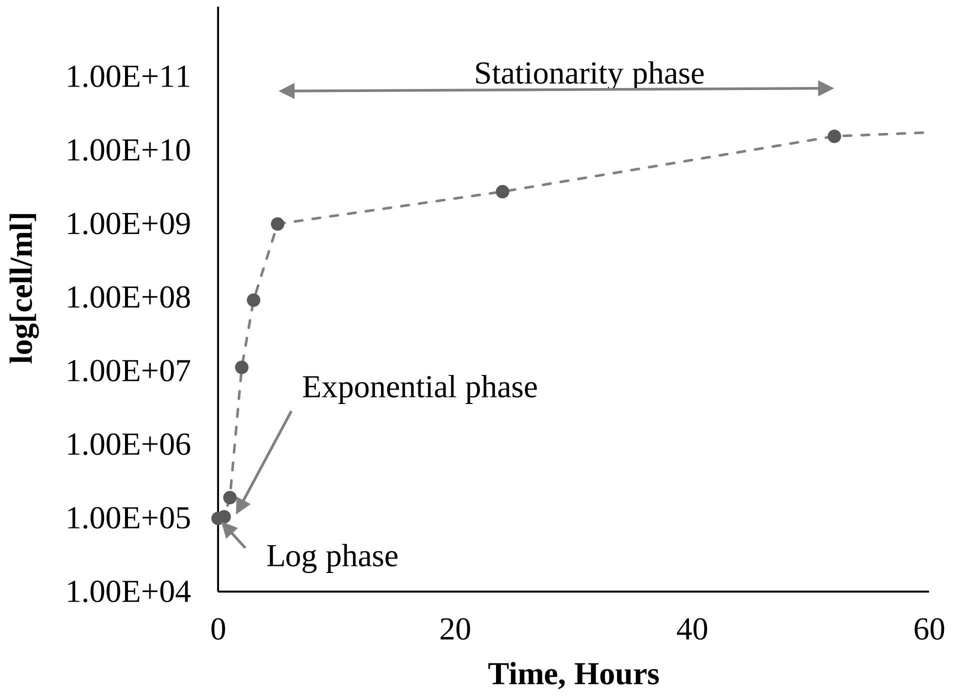

Figure 1. Growth curve of *S. carnosus* bacteria

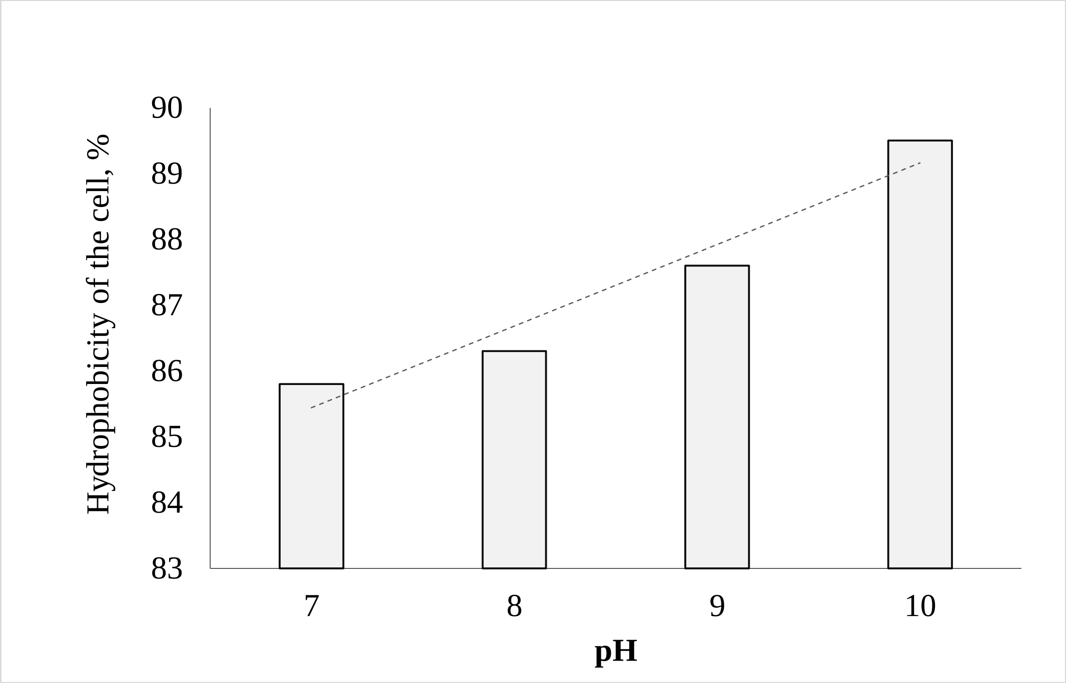

Figure 2. Hydrophobicity of the bacteria as a function of pH

Results

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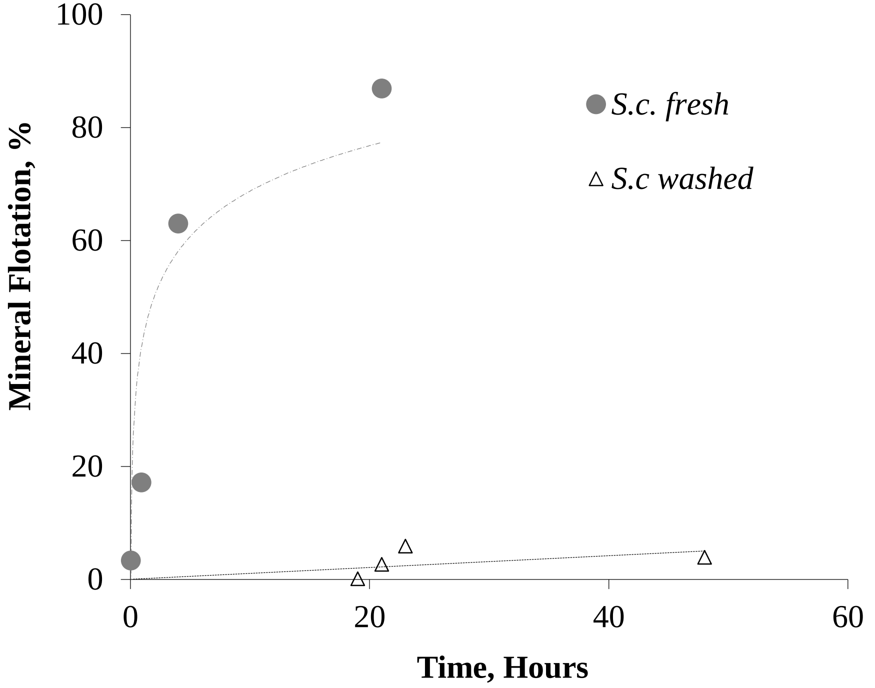

Figure 3. Effect of the culture period the bacteria in the floatability of the chalcopyrite with fresh bacteria (culture medium) and washed bacteria (without culture media).

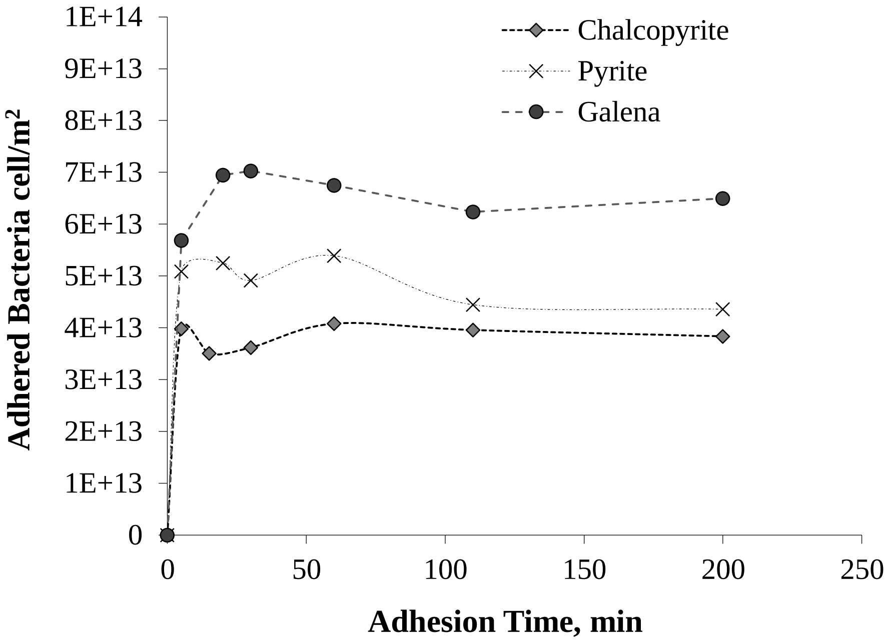

Figure 4. Effect of the floatability of *S.carnosus* + $CuFeS_2$ bacteria with culture medium and without culture medium at pH 9

Results

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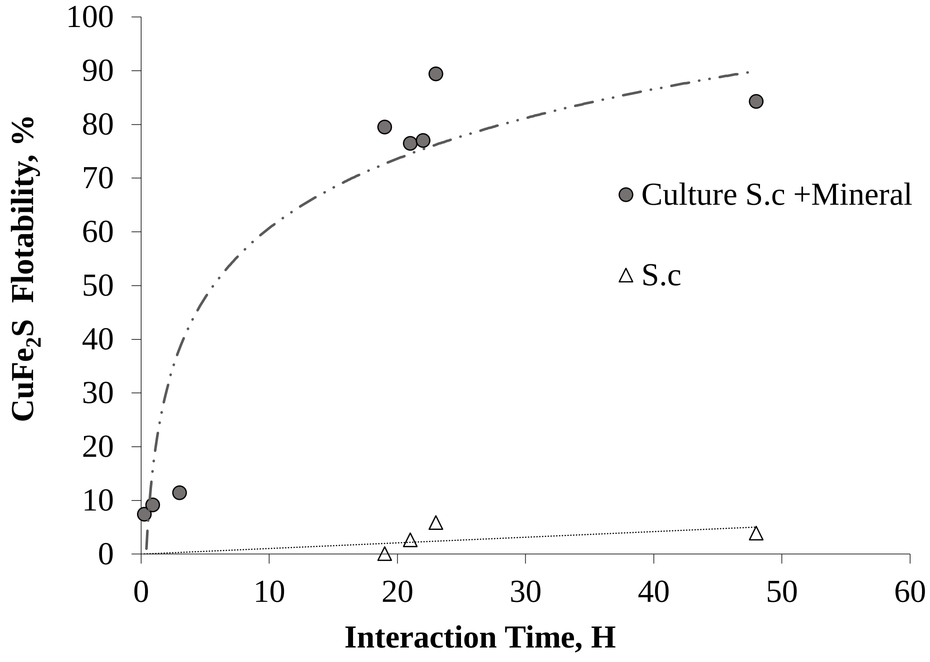

Figure 5. Adhesion isotherms of *S. carnosus* bacteria with minerals of interest at pH 9

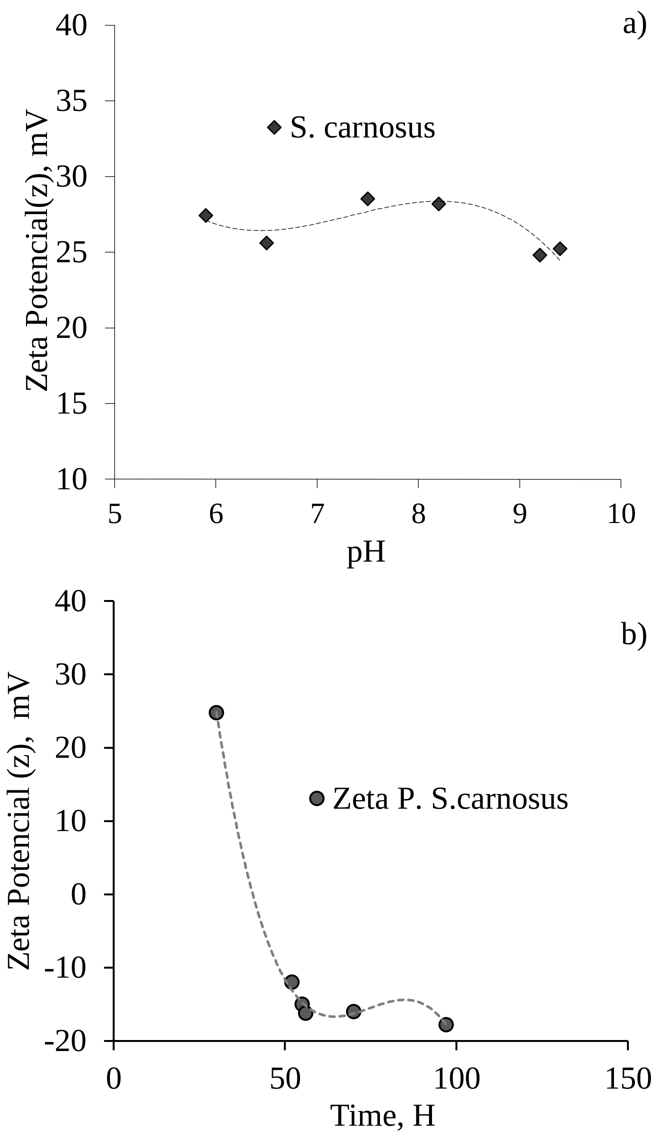

Figure 6. Zeta potential of *S. carnosus* bacteria (control) depending on: a) pH and b) Time (H)

Results

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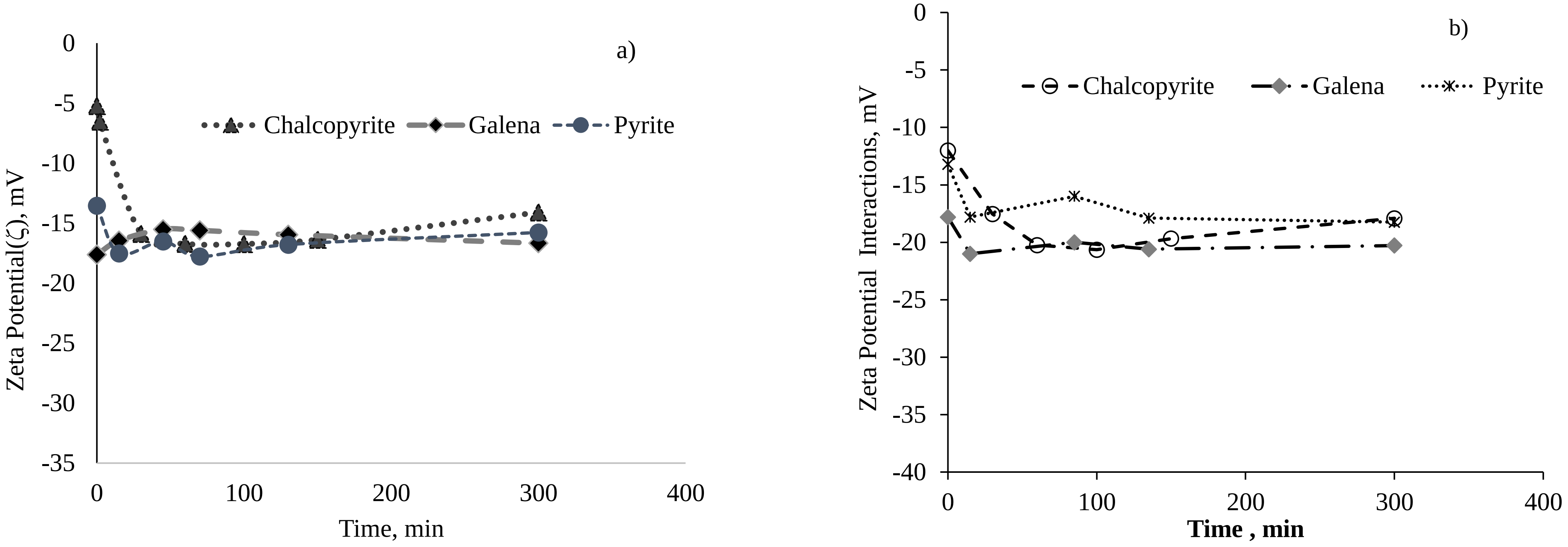

Figure 7. Zeta potential of S. *carnosus* bacteria with the mineral of interest. a) Before the interaction and b) after the interaction

Results

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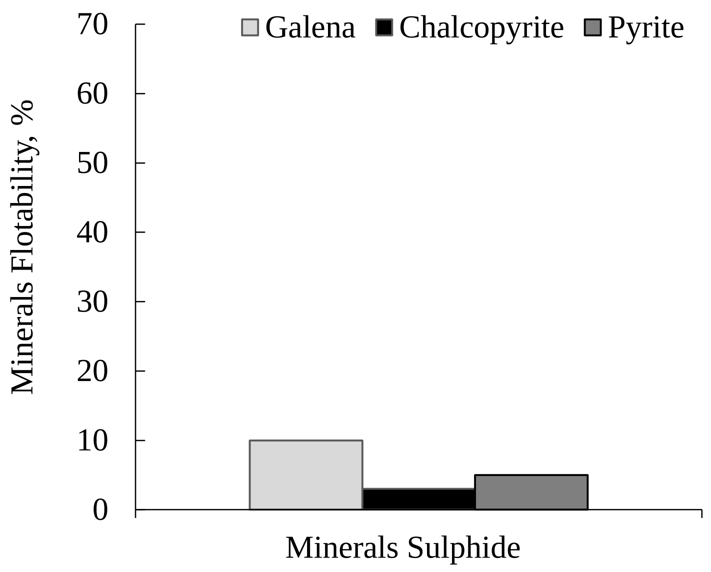

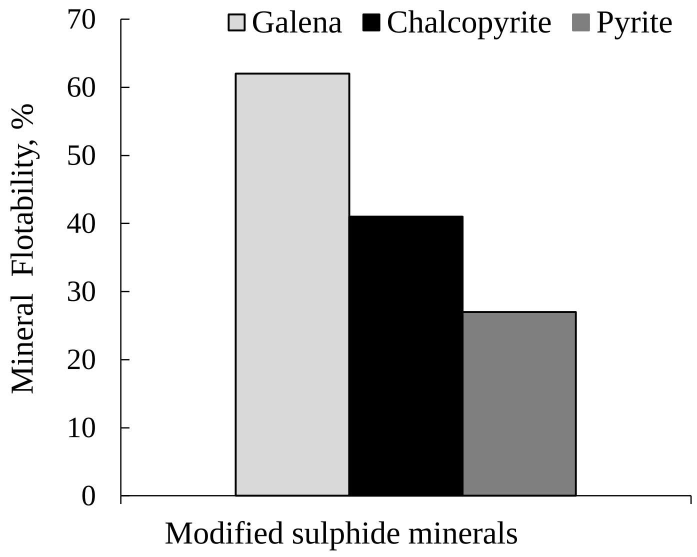

Figure 8. Floatability of the natural mineral at pH 9. Minerals conditioned in a 1 x 10^{-3} M solution of NaNO3 at pH 9, in the absence of bacteria

Figure 9. Floatability of bio-modified minerals. After interaction with *S.carnosus* bacteria at a pH of 9.

Annexes

ADHESIÓN DE BACTERIA

$$B_{Ad} = \frac{(B_0 - B)V}{wA_m}$$

Where: B_{Ad} is adhering bacteria (cell/m^2); B_0 and B are the concentration of free bacteria at zero time and t, respectively (cell/ml); V is the volume of sample in ml; w is the exact weight of mineral in grams, A_m is the surface area determined by Coulter counter mineral

Conclusions

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- From the results, it can be concluded that *S. carnosus* has a hydrophobic effect on minerals, resulting on its adherence on surface minerals and acting as a natural collector. The bio-modification generates different degrees of minerals hydrophobicity, which indicates the possibility to control the bio-collector for selective separation of minerals. The magnitude of the floatability of minerals showed the descending order as follows:
  - galena >> chalcopyrite> pyrite
- The sulfides mineral bio-modification mechanism was evaluated in the presence of *S. carnosus* and the results shows a physical mechanism, due to the electrostatic attraction generated between the bacterial surface charge or positive zeta mineral powder and negative surface charge (negative zeta potential).
- It is concluded that the usage of this strain are promising for environmentally friendly bioreagent, thus being applicable for the eco-friendly development of the bioflotation of sulfide minerals.

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