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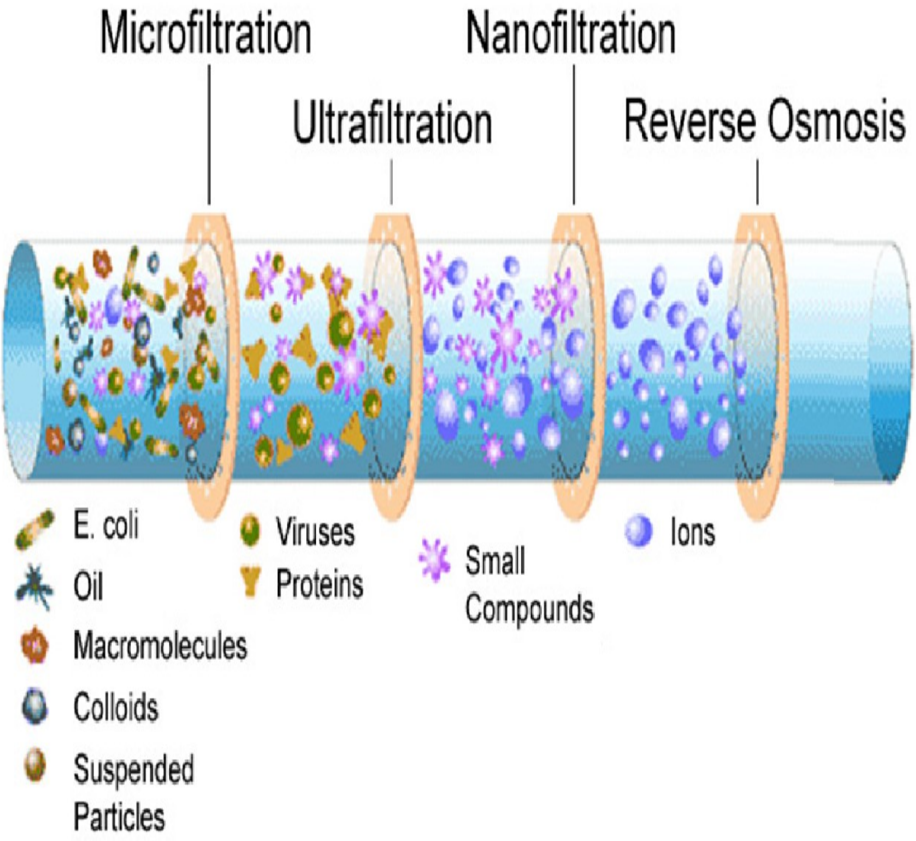

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SUMMARY

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Sciences & Technology **Vol 5 – N°2**, December 2020, pp. 07-11

A STUDYING ABOUT SOME CHARACTERIZATION OF FINITE MATROID GROUPS

Submited on 09/02/2020 – Accepted on 10/11/2020

Abstract

In this work, we show that a very large class of matroid groups possesses the basis property. Moreover, we show that this class behaves like vector spaces in terms of basis. Applications include new proofs for the characterization of finite matroid groups. Moreover, we show that every group possesses BEP, also possesses the span property and in the definition of matroid group, the extension property can be replaced by BEP. The fact that BEP always correct in vector spaces, but the situation is different in groups was showed. In the end, we show that each base and maximal independent subset are equivalent in any group with embedding property.

Keywords: *Matroid group, basis property,basis exchange property, extension property*

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I- INTRODUCTION

Matroid theory contributes in several fields of sciences such as Coding Theory, Electronics and Computer Science [1]. The word ”matroid” came first from ”matrix”, and then it has its own structure.

Recently the notion of matroid group was introduced by several mathematicians. They studied the structure of such groups [2], [3].

II. PROBLEM STATEMENT AND FUNDAMENTAL CONCEPTS

Definition 1 : [4].A group G is called a group with basis property if there exists a basis (minimal generating set) for every subgroup H of G and every two bases are equivalent.

A group G is called a group with exchange property, if $x \notin \langle X \rangle \wedge x \in \langle X \cup \{y\} \rangle$, then $y \in \langle X \cup \{x\} \rangle$, for all $x, y \in G$ and for every subset $X \subseteq G$.

Definition 2: A generating set X is said to be minimal if it has no proper subset which forms a generating set. The subset X of a group G is called independent, if for all $x \in X \wedge x \notin \langle X \setminus \{x\} \rangle$. Independent set X is called a basis subgroup $\langle X \rangle$.

Example 1: Let (Z; +) be an additive abelian group, then we can write $Z = \langle 1 \rangle = \langle 2,3 \rangle$ even though $2 \notin \langle 3 \rangle$ and $3 \notin \langle 2 \rangle$. Thus Z does not have the basis property. Hence free groups do not have the basis property.

Definition 3: A matroid M is an ordered pair (E, Ω) consisting of a finite set E and a nonempty subset Ω of the power set (E) such that ;

(a) If $I \in \Omega$ and $I_0 \subseteq I$ then $I_0 \subseteq \Omega$. (Hereditary Property).

(b) If $I_1, I_2 \in \Omega$ and $1 + |I_1| = |I_2|$, then there exists an element $e \in I_2 - I_1$ satisfying $I_1 \cup \{e\} \in \Omega$ (Extension Property).

The elements of Ω are called independent where the elements of $(E) \setminus \Omega$ are called dependent. Matroid basis are defined to be the maximal elements of Ω.

The concepts of independence and basis should be clarified before we go on. The condition (a) is satisfied for each group G when we assume that the elements of Ω are the independent subsets of G . This is obvious since if the elements $x_1, \ldots, x_r$ are independent in the sense that non of them can be written in terms of the others, then any subset of $\{x_1, \ldots, x_r\}$ is independent. It should be pointed out that, in groups, each base is a maximal independent element of Ω, but the converse is not true. Here is an examples.

Example 2: In A_4, the subset $\{(12)(34), (13)(24)\}$ is independent and maximal, but certainly is not a base.

Definition 4: A group is satisfying the ”embedding property” if each independent subset can be embedded in a base.

From this definition, one deduces that, base and maximal independent subset are equivalent in any group with embedding property.

Definition 5: A group G is said to be matroid if it satisfies

(a_1) the empedding

(b_1) extension properties

Example5: A typical example of such groups is the finite elementary Abelian groups as they can be viewed as vector spaces over the finite Galios field $GF(p)$. But not all groups are matroid, for if we consider D_4, the dihedral group $\langle x,y\ ;x^2=y^4=1\ ,\ x^{-1}yx=y^{-1}\rangle$, the $X=\{x,y^2\}$ is independent but cannot be embedded in any base.

For non-Abelian case, one may take S_3 to see that it is a matroid group.

III. MATROID GROUPS AND BASISPROPERTY

Remember that we say a group G has the "span property" if for any two bases X,Y for G then $|X|=|Y|$ If in addition, the same thing is true for all subgroups of G, then G is said to have the "Basis Property". In other words, G has the basis property if all its subgroups have the span property [5], [6].

Proposition 1: Matroid groups possess the span property.

Proof. Let B_1, B_2 be two bases of a matroid group, and assume that $|B_1|<|B_2|$, so there exists an independent subset $B\subseteq B_2$ such that $|B|=|B_1|+1$, and thus there exists an element $x\in B-B_1$ such that $B_1\cup\{x\}$ is independent according to (b_1). But B₁ is a base of the group, so it is maximal independent subset. Therefore, $B_1\cup\{x\}$ is dependent. This contradicts what we just stated.

Proposition 2: Matroid groups possess the basis property.

Proof. Let H be a proper subgroup of a matroid group G. Consider the two bases of H, $X=\{x_1,...,x_r\}, Y=\{y_1,...,y_l\}$. By (a_1), both bases can be extended to bases for G. This means there exist elements s_i such that $\{x_1,...,x_r,s_1,...,s_k\}$ is a base of G. By Proposition 1, any base of G contains exactly $r+k$ elements. Now, it is clear that $H\subseteq\{y_1,...,y_l,s_1,...,s_k\}$, and also any element of $G-H$ can be expressed in terms of x_is and s_is , but any x_i can be expressed in terms of $y_i s$,thus any element of G can be written in terms of $y_i s$ and $s_i s$ .Therefore $\langle y_1,...,y_l,s_1,...,s_k\rangle=G$ .This implies that $r+k\le l+k$ or $r\le l$. We may switch X with Y in the above argument to see that $r\ge l$. Hence $r=l$, and G has the basis property.

This leads to a notion similar to the dimension in vector spaces.

In matroid groups, the number of elements in any base is called the "rank" for the matroid group G , and it is denoted by $\delta(G)$.

Proposition 3: For a matroid group G . If H is a proper subgroup of G , then $\delta(H)\le\delta(G)$.

Proof: Let B be a base of H . So, B contains independent elements, and by (a_1), B can be embedded in a base X for G containing B with $|B|<|X|$ or $\delta(H)\le\delta(G)$.

IV. MATROID GROUPS AND BASIS EXCHANGEPROPERTY

Definition 6: A group G is said to have the basis exchange property (BEP) if for any two bases B_1,B_2 for G , if there exists an element $x\in B_1-B_2$, then there exists an element $y\in B_2-B_1$ such that $(B_1-\{x\})\cup\{y\}$ is a base for G .

This special property is always correct in vector spaces, but the situation is different in groups. To demonstrate this point, let us focus on the following example.

Example 6: In S_9, let $a=(123)(456)(789)$, $b=(147)(258)(369)$ $c=(24)(37)(68)$. The calculations show that $(ac)^3=(16)(29)(57)$.

we consider the group $G=\langle a,c\rangle$,and let $x=(ac)^2$, $y=(ac)^3$ and $z=yc$.

We easily find the two bases $B_1=\{ac,b\}$, $B_2=\{x,y,z\}$. Replacing z by ac gives the subset $\{x,y,ac\}$ which generates only $\langle ac\rangle\ne G$ .The subset

$\{x,y,b\}$ is dependent since $x \in \langle y,b \rangle$ .Hence G does not possess the BEP. One notices that G does not possess the span property either. This example is revealing, and we state this proposition.

Proposition 4: If a group G possesses the BEP. Then it satisfies the span property.

Proof: Assume the contrary. That is G has two bases B_1, B_2 with $|B_1| < |B_2|$. Let us choose these two bases such that $|B_1 - B_2|$ is the least possible difference. Obviously, $B_2 - B_1 \neq \phi$, since otherwise B_1 would not be maximal. Now, let $x \in B_2 - B_1$. By BEP, there exists $y \in B_1 - B_2$ such that $(B_2 - \{x\}) \cup \{y\}$ is a base. But $|(B_2 - \{x\}) \cup \{y\} - B_1| < |B_2 - B_1|$. This contradicts the minimality of $|B_2 - B_1|$,and hence leads to $|B_1| = |B_2|$.

Proposition 5: Matroid groups have the BEP.

Proof: Let B_1, B_2 be two bases of a matroid group G . Let $x \in B_1 - B_2$. Proposition 1 shows that $|B_1| = |B_2|$, and we know that both $B_1 - \{x\}$ and B2 have independent elements. Obviously, $|B_2| = |B_1 - \{x\}| + 1$, so there exists $y \in B_2 - (B_1 - \{x\})$ such that $(B_1 - \{x\}) \cup \{y\}$ is independent. By the extension property, it can be extended a base. But since $|(B_1 - \{x\}) \cup \{y\}| = |B_1|$, then $(B_1 - \{x\}) \cup \{y\}$ is a base itself.

In the definition of matroid group, the extension property can be replaced by BEP.

Proposition 6: Let G be a group with the embedding property. Then the following properties are equivalent.

(i) Extension property.

(ii) Basis exchange property.

Proof: $(i) \Rightarrow (ii)$. Let G be satisfying the extension property. Since G has the embedding property. So G is matroid. According to the previous proposition, G has the basis exchange property.

$(ii) \Rightarrow (i)$ Assume that G has the BEP and G dose not satisfy the extension property. Thus, there are two independent sets I_1, I_2 where $|I_2| = |I_1| + 1$ and for all $e \in I_2 - I_1$ the set $I_1 \cup \{e\}$ is dependent. Embedding property leads to existence of two bases B_1, B_2 such that $I_1 \subseteq B_1$,$I_2 \subseteq B_2$. Choose B_1, B_2 such that $|B_2 - (I_2 \cup B_1)|$ is minimal. Notice that $I_2 - B_1 = I_2 - I_1$, because $(I_2 - I_1) \cap B_1 = \phi$ due to adding any element of $I_2 - I_1$ to I_1 would make the set B_1 dependent. Now $B_2 - (I_2 \cup B_1) = \phi$ for otherwise, one can choose $x \in B_2 - (I_2 \cup B_1)$ and by BEP, there exists $y \in B_1 - B_2$ with $(B_1 - \{x\}) \cup \{y\}$ is a base. But $|(B_2 - \{x\}) \cup \{y\} - (I_2 \cup B_1)| < |B_2 - (I_2 \cup B_1)|$ which contradicts our choice of B_2. So, $B_2 - B_1 = I_2 - B_1$ and hence $B_2 - B_1 = I_2 - I_1$. Moreover, $B_1 - (I_1 \cup B_2) = \phi$ for otherwise, there will be an element $x \in B_1 - (I_1 \cup B_2)$, and therefore, there exists $y \in B_2 - B_1$ such that $(B_1 - \{x\}) \cup \{y\}$ is a base for G . Now $I_1 \cup \{y\} \subseteq (B_1 - \{x\}) \cup \{y\}$, so $I_1 \cup \{y\}$ is independent, and since $y \in B_2 - B_1 = I_2 - I_1$ we reach a contradiction with our assumption. Thus, $B_1 - B_2 = I_1 - B_2 \subseteq I_1 - I_2$. But $|B_1| = |B_2|$ this means that $|B_1 - B_2| = |B_2 - B_1|$ and we may deduce that $|I_2 - I_1| \leq |I_1 - I_2|$ or $|I_2| \leq |I_1|$ which is a contradiction.

From this statement, one may define the matroid group to be any finite group that satisfying embedding property and the BEP.

5. THE CHARACTERIZATION OF MATROID GROUPS

A subset X of a finite group G is called independent, respectively Frattini-independent, if there is no proper subset $Y \subset X$ such that $\langle X \rangle = \langle Y \rangle$, respectively $\langle X \cup \phi(G) \rangle = \langle Y \cup \phi(G) \rangle$. The group G is called a matroid group if G has property B and every Frattini-independent subset of G can be extended to a minimal generating set of G .Alternatively, G is a matroid group if $H = G / \phi(G)$ is a Frattini-free $\mathrm{B}-$group and every independent subset of H can be extended to an minimal generating set. The definition of a matroid group given here is the one used in [3]. We obtain a small variation of the characterization of matroid groups in [3].

Theorem 1: Let G be a finite group. Then G is a Frattini-free $\mathrm{B}-$group if and only if one of the following holds:

(1) G is an elementary abelian $p-$group for some prime p ;

(2) $G=P\times Q$, where P is an elementary abelian $p-$group and Q is a non- trivial cyclic $q-$group, for distinct primes $p\neq q$ such that Q acts faithfully on P and the F_pQ-module P is a direct sum of isomorphic copies of one simple module.

Remark1: This means that there are no Frattini-free finite $\mathrm{B}-$groups beyond the examples constructed in [7]. Indeed, the groups listed in (2) of Theorem1.3can be concretely realized as semi direct products via multiplication in finite fields of characteristic p : the simple module in question is of the form $F_p(\zeta)$, the additive group of a finite field generated by a q^k throot of unity ζ over F_p, with a generator z of Q acting on $F_p(\zeta)$ as multiplication by ζ .

Theorem 2 :[3]. Let G be a finite group and let $H=G/\phi(G)$.The group G is a matroid group if and only if one of the following holds:

(1) G is a $p-$group for some prime p ,

(2) $H=P\times Q$, where $P\cong F_p^d$ and Q is cyclic of order q , for primes p,q such that $q/p-1$, and $Q\rightarrow F_p^\times$ acts on P via field multiplication.

Proof: By the Burnside basis theorem every finite group of prime-power order is a matroid group. From now suppose that G does not have prime-power order.

First suppose that G is a matroid group. Then, by Theorem1 and Remark1 , the Frattini quotient H is a matroid group of the form $H=P\times Q$, where P is an elementary abelian $p-$ group and Q is a non-trivial cyclic group of order q^k , for distinct primes $p\neq q$, such that $Q\rightarrow F^\times$ acts faithfully on $P\cong F^d$ via multiplication in a finite field F .Here F is obtained from F_p by adjoining a primitive $q^k th$ root of unity and we set $r=\left[F:F_p\right]$. We observe that the common size of all minimal generating sets of G is $d+1$.

Being isomorphic to an F_P-vector space of dimension rd , the subgroup P contains an independent subset of size rd . This subset extends to a minimal generating set of H . We deduce that $rd\leq d$, thus $r=1$. Let z be a generator of Q and assume for a contradiction that $k\geq 2$. Choose a minimal generating set X for P as an F_pQ-module. Then $X\cup\{z^q\}$ is an independent set of size $d+1$ that does not generate H and does not extend to a minimal generating set of H . This implies that H is not a matroid group in contradiction to our assumptions. Hence, $k=1$, i.e., Q is cyclic of order q . From $Q\rightarrow F_p^\times$ we obtain $q/p-1$.

Conversely, suppose that $H=P\times Q$, where $P\cong F_p^d$ and $Q=\langle z\rangle$ is cyclic of order q , for primes q,p such that $q/p-1$, and $Q\rightarrow F_p^\times$ acts on P via field multiplication. By Theorem 1 the group H has property B and it suffices to show that every independent subset of H extends to a minimal generating set. Let $X=\{x_1,\dots,x_m\}\subseteq H$ be an independent subset of size m .If $X\subseteq P$ then, regarding P as an F_p-vector space, we extend X to a minimal generating set of P and add the generator z of Q to obtain a minimal generating set of H . Now suppose that $X\nsubseteq P$ .Since H does not contain any element of order pq , we may assume without loss of generality that $x_1=z$. Then $X=\{z,v_2z^{j_2},\dots,v_mz^{j_m}\}$ where $\{v_2,\dots,v_m\}\subseteq P$ is an independent subset of size $m-1$ and $j_2,\dots,j_m$ are integers.

We extend $\{v_2,\dots,v_m\}$ to a minimal generating set $\{v_2,\dots,v_d\}$ of P . Then $X\cup\{v_{m+1},\dots,v_d\}$ is a minimal generating set of H .

Using Theorem 1.5 we obtain the following consequence.

Corollary 1: Let G be a finite group. Then G is a matroid group if and only if one of the following holds:

(1) G is a $p-$group for some prime p ,

(2) $G=P\times Q$, where P is a $p-$group, Q is a cyclic $q-$group for primes q,p such that $q/p-1$, $Q/C_Q(P)$ has order q and acts on $P/\phi(P)$ fixed-point-freely.

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EXTRACTION PROCEDURE FOR COPPER (II) IN ACETATE MEDIUM BY NANOFILTRATION AND REVERSE OSMOSIS

Submited on 19/02/2020– Accepted on 22/10/2020

Abstract

The retention of copper ions from a synthetic solution by nanofiltration and reverse osmosis has been shown to be a feasible process to achieve efficient copper extraction. In this study, we investigate the effect of varying pressure, pH, and copper acetate concentration.

The experimental results indicated that the retention of copper ions increase with increasing operating pressure, decrease with increasing concentration and were strongly influenced by the pH of the feed solution. Higher degrees of copper extraction were obtained for experiments carried out by reverse osmosis than those carried out by nanofiltration.

The results show that, the extraction efficiency of copper by reverse osmosis varied from 90% to 100 % for an initial feed concentration of 50 ppm, and by nanofiltration ranged from 49 % to 98% and from 24% to 73 % for an initial feed concentration of 50 and 75 ppm, respectively.

B. AOUFI

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Keywords: *Copper, Nanofiltration, Reverse osmosis, Retention, Extraction*

I- INTRODUCTION

Copper is a widely used heavy metal in many engineering and chemical industries due to its electrical and thermal conductivity, the great difficulty being that heavy metals are not biodegradable and tend to accumulate in organisms [1]. For this, the treatment of aqueous effluents has become imperative.

Many processes are used to purify water contaminated with heavy metals; these methods are effective but have many drawbacks which require the use of organic solvents harmful to the environment.

Membrane processes were found to be feasible for the removal of heavy metals from an aqueous solution due to their relative ease of construction and control and the possible recovery of precious metals [2].

The aim of this work is to investigate the ability of the SNTE NF270-2540 nanofiltration membrane to remove Cu(II) ions from aqueous solutions and compared with the xle 2540 reverse osmosis., To this end, the effect of operating parameters (applied pressure, feed pH and concentration) on the membrane performance is systematically investigated.

2. EXPERIMENTAL

2.1. Reagent and solutions

Copper acetate salt was supplied by Carlo Erba (France), hydrochloric acid (38%) and 1-(2-Pyridylazo)-2-naphthol (PAN) were purchased from Sigma-Aldrich (Germany).

All solutions were prepared by dissolving the appropriate weight of the salt in water and made to a volume of 40 L.

2.2. Analyses

Copper ion concentration was measured by a UV-Visible spectrophotometer type (SPECORD 210/plus) purchased by Analytik Jena Specord (Germany), takings of 100 µL of copper are measured by UV-VISIBLE after the addition of 2 mL of stamp solution with pH = 4.0 and 100 µL of PAN.

2.3. Materials

A commercially nanofiltration membrane (SNTE NF270-2540) and reverse osmosis membrane (XLE- 2540) supplied by DOW FILMTEC™ Membranes (USA) was used in this study (Table 1).

The pH value was measured with a pH - meter AD 1030 (Adwa, Hungary).

The weighing was made with an electronic analytical balance type OHAUS (USA).

Pilot equipment

Nanofiltration and reverse osmosis experiments was performed with tangential filtration unit (Fig.1), in this experiments the retained liquid the permeate is returned to the tank. For each admitted pressure, the experiment time was 15 minutes.

CA is the cartridge filter with activated carbon and 25 µm of wound cartridge filter. S is the safety valve (14 bars). B1 is the feed tank (100 L). B2 is the permeate tank (20 L). C2 is the nanofiltration membrane. FI1 is the upstream flow meter (100–1000 l/h). FI2 is the downstream flow meter of retentive. FI3 is the downstream flow meter of permeate. PI1 & PI2 are the manometers at upstream and downstream of module (0–16 bars). PI3 & PI4 are the monitoring manometers of filters state (0–2.5 bars). LSL1 is the low level sensor (pump safety). CE1 is the Sensor of permeate conductivity measuring. Y is the emptying, CIT1 to the electrical display cabinet. V1–5, 7, 10, 11, 14–16, 19 & 22 are the pressure regulation valves for nanofiltration process. P is the multistage centrifugal pump (high pressure).

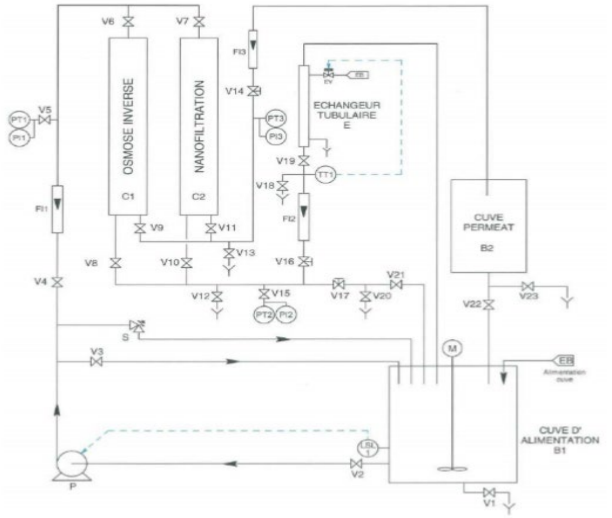

Figure 1. Schéma de principe.

Table 1. Characteristics of OI and NF membranes

Characteristics	OI membrane	NF membrane
Membrane model	XLE- 2540	NF 270-2540
Membrane material	Polyamidethin-film composite	Polyamide thin-film composite
Membrane configuration	Spiral wound	Spiral wound
Membrane surface area, m^2	2.6	2.6
Allowable operating pH range	2-11	2-11
Maximum operating pressure, bar	41 (600 psi)	41 (600 psi)
Maximum operating temperature, °C	45 (113 °F)	45 (113 °F)
Free chlorine tolerance, ppm	< 0.1	< 0.1
Maximum feed turbidity, NTU	1	1

2.4. Data analysis

The retention was calculated by Eq (1):

$$Y(\%) = \left(\frac{C_0 - C_P}{C_0}\right) \times 100 \qquad (1)$$

Where Cp and C_0 represent permeate and feed solution concentration (ppm).

3. RESULTS AND DISCUSSION

3.1. Extraction of copper

3.1.1. Permeate flux

Figure 2 shows the evolution of the permeate flow as a function of the pressure for Cu (II) solutions at different concentrations ranging from 50 ppm to 75 ppm. We note that for each solution the permeate flow increases with the increase of pressure.
The permeate flux of 75 ppm solutions is less than that of water. In this case, the transfer of solvent is favored over the solute [3-5], These results are in agreement with the hypothesis which states that the presence of solutes makes it difficult for the membrane surface to be more compact due to the contraction of the pores, which leads to a decrease in permeation [6].

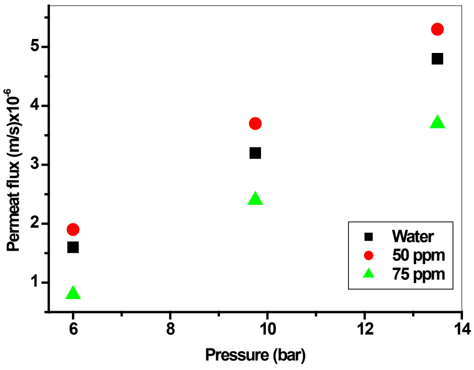

Figure 2. *Variation of permeate flux according to the pressure.*

3.1.2. Effect of pressure

The results obtained in figure 3 shows that the retention of Cu (II) ions increases with increasing pressure.

This increase in retention is explained by the increase in water flow due to pressure, and the transfer of ions through the membrane does not increase in the same way.

Thus, the ion will be shared in a large volume of water, which means that the permeate solution will be less concentrated and therefore the retention increases. We work in total recycling where the two permeate solutions and the retentate have been returned to the feed tank in order to keep a constant concentration. This phenomenon has been observed by previous Works [7, 8].

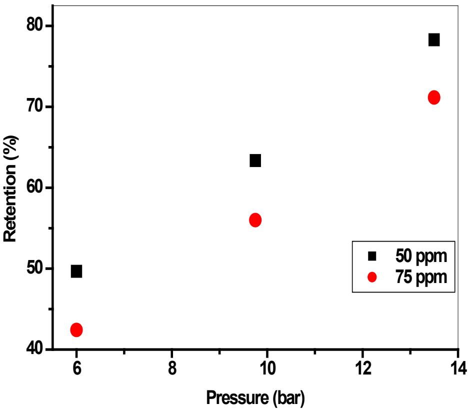

Figure 3. *Variation of copper retention according to the pressure.*

3.1.3. Effect of pH

The rejection from nanofiltration membranes is due to both size exclusion and co-ionic electrostatic repulsion (or exclusion of charge) [9]. It has been acknowledged that the polyamide membrane are negatively charged at pH above the isoelectric point and positively charged at pH under the isoelectric point, and zero charge at the isoelectric point. For the NF270-2540 membrane the isoelectric point measured was in the pH <3 [5].

Figure 3 presents the effect of Copper retention according to the pH for different pressures

At pH=5.0, where the membrane pore is more negatively charged, the copper ion experiences electrostatic repulsion from the membrane pore and will be rejected by the membrane. Because the electroneutrality of the permeate solution must be maintained. As the pH decreases the electrostatic repulsion and therefore the ion rejection decreases, at pH =4.0 the rejection reaches a local minimum, resulting in an increase pore size and salt passage [9].

At strong acidic pH (pH=3.0), the increase in protons in the solution induces a progressive neutralization of the negative sites on the surface of the membrane. Then, as the repulsion of co-ions decreases, their transfer increases. In this case, the retention of the ions depends only on their size and their mobility. Protons which are characterized by high mobility (34.90 x10^{-9} m^2 /s.V), small size and high diffusion coefficient (9.34 × 10^{-9} m^2.s^{-1}) pass easily through the membrane carrying acetates with them to restore electroneutrality on both sides of the membrane [10].

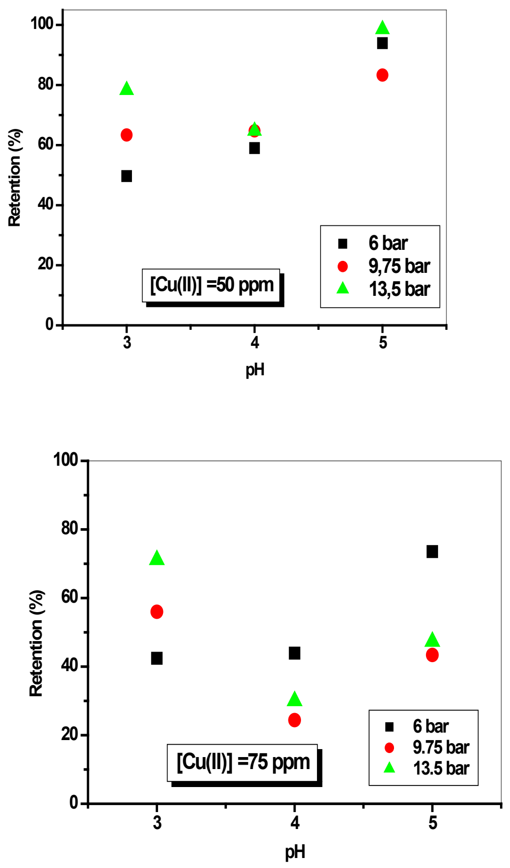

Figure 4. *Variation of copper retention according to the pH for different pressures.*

3.15. Effect of concentration

It is noted that the retention of solutions decreases with increasing concentration (Figure 5). These results are attributed to the phenomenon of concentration polarization, which tends to decrease the flow of the permeate and consequently the decrease in the retention of metal ions by membrane [11,12].This is also explained by the neutralization of the negative sites of the membrane due to the increase in positive charges, resulting from the metal ions, which reduces the power of the membrane in the rejection of the ions, and consequently the reduction of the flux of permeate [12], This result is in agreement with that previously found [4,13].

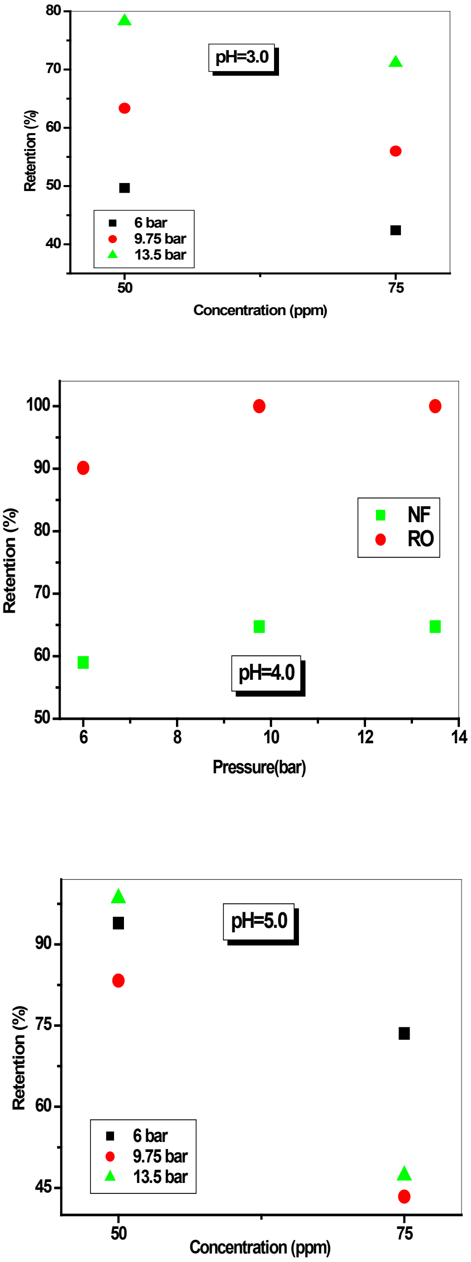

Figure 5. *Variation of copper retention by RO and NF processes.*

Conclusions

In this work, the performance of the Nanofiltration and Reverse Osmosis processes as a thin film composite membrane in removing copper from a synthetic solution was studied, the influence of changing the pressure, concentration and pH of copper acetate in the feed solution on the transport of water and salt, The results show that, the extraction efficiency of copper by reverse osmosis varied from 90% to 100 % for an initial feed concentration of 50 ppm, and by nanofiltration ranged from 49 % to 98% and from 24% to 73 % for an initial feed concentration of 50 and 75 ppm, respectively.

The results obtained show that copper (II) was successfully removed by Reverse Osmosis than the Nanofiltration.

The best initial conditions were copper (II) concentration equal to 50 ppm, initial pH=3.0, and pressure equal to 6 bars with extraction yield of 100 % was obtained by reverse osmosis.

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THE EFFECT OF SOLAR REGULATORS ON THE PERFORMANCE AND ENERGY PROVIDED BY SOLAR SYSTEM

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Abstract

Presently, Photovoltaic and the outher resources such as the wind, the geothermal and biomass energy are the most important energetic alternative resources; in this work an experimental study of a solar system has been proposed; located in the energy site of the city of Constantine. The aim of this article is to evaluate the effect of the diffrence betwen hybrid regulateur and MPPT charge controlleur in solar system.

Keywords: *Photovoltaic; MPPT charge controller; Solar batteries; Hybrid Controller.*

Abbreviations : **MPPT :** Maximum Power Point Tracking /**AC :** Alternating current / **DC :** Direct current / **PV :** Photovoltaic/ **Vin:** the input voltage of the Generator PV/ **Vbatt:** the voltage of solar batteries / **Pin** : the input power of the solar controller

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I- INTRODUCTION

In solar energy, Algeria has one of the largest solar challenges in the world. The energy received daily on a horizontal surface of 1 m2 is 5 kWh. It is about 1,700 kWh / m2 / year in the north and 2,263 kWh / m2 / year in the south [1],[2]. Several investigations have been carried out for the optimal design of the autonomous solar system [3],[4].

Solar charge controllers such as the MPPT and PWM and hybrid controllers; have become essential components of the performance evaluation of Photovoltaic Power Systems.

The purpose of this article is to examine how the difference between a MPPT controller and a hybrid controller affects the input voltage of the GPV; and the power delivered by the system; and the voltage of the solar batteries.

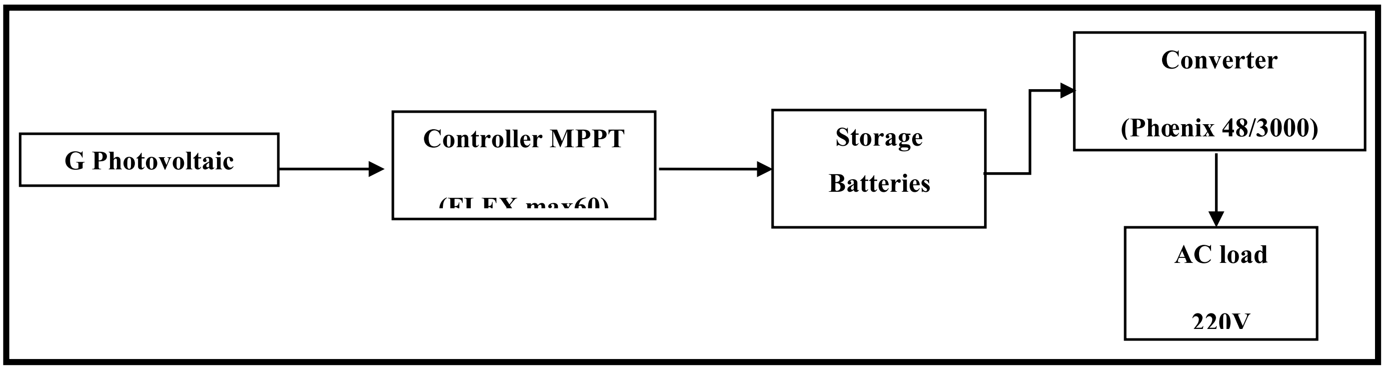
Ⅱ. DESCRIPTION OF THE SYSTEM:

In this study the system consists of two photovoltaic solar panels of polycrystalline silicon type; placed in series so a group of 390W; The structure of this application is coupled with 4 batteries assembled in series (12V, 200Ah), the battery group voltage is set to be (48V, 200Ah). Photovoltaic panels transform solar radiation into direct current (DC); this voltage is connected to the MPPT controller input (FLEX max60), For 220V AC loads; a converter (Phoenix48 / 3000) is used to convert 48V DC to 220V AC, and in the other study the MPPT controller has been replaced by a HOPEFUL hybrid controller (HF-GF-1000).

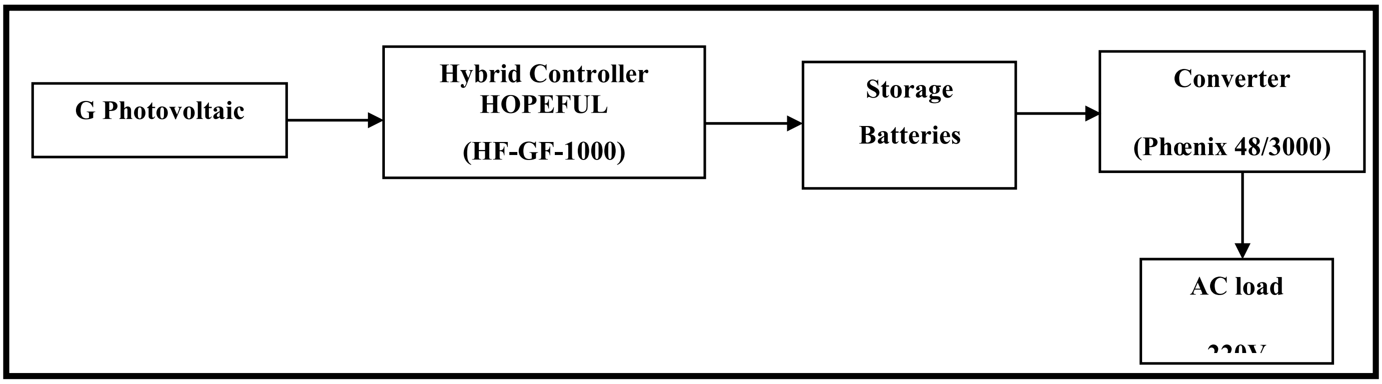
Fig1: presentation of the system

The performance of the system was evaluated for 5 hours from 9:00 to 14:00.

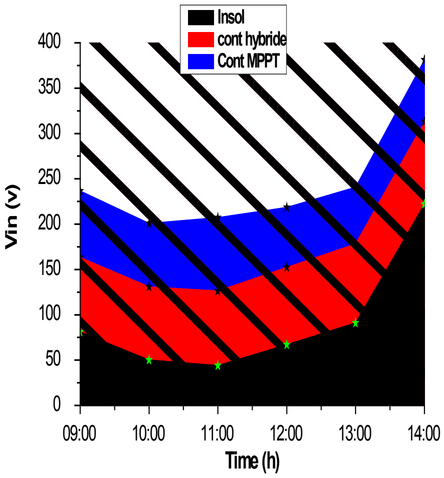
Study1 : With Mppt Charge Controller



Study 2: With Hybrid Controller HOPEFUL



Ⅲ. RESULTS AND DISCUSSION:



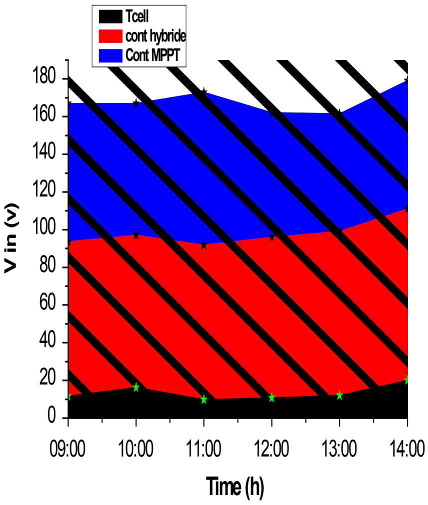
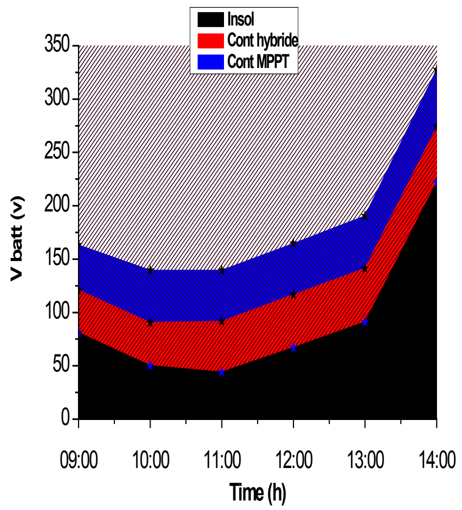


Fig2: Variation of global radiation with the input voltage of solar regulators

Fig3: Variation of the temperature of solar cell with the input voltage of solar regulators



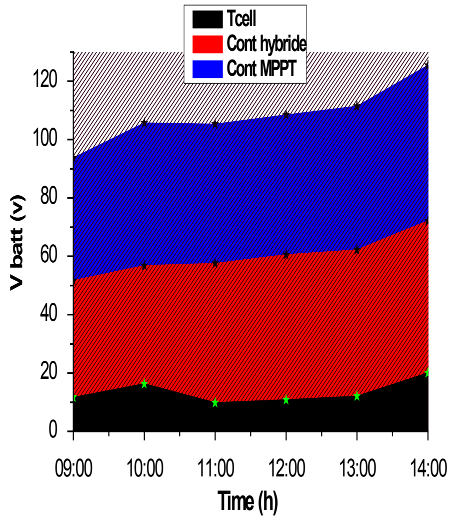


Fig4: Variation of the global radiation with the voltage of solar batteries

Fig5: Variation of the temperature of solar cell with the voltage of solar batteries

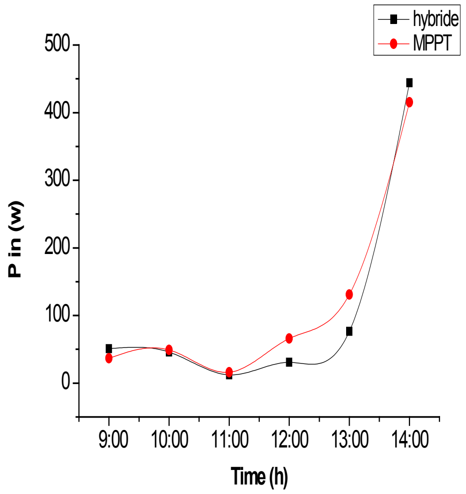


Fig6: Variation of the power delivered by the photovoltaic generator as a function of time

- The voltage supplied by the PV generator varies with the global radiation and with the temperature of the solar cell.
- The voltage of solar batteries also depends on the temperature of the solar cell and also with the global radiation.
- Input Power of solar regulators (MPPT and Hybrid Controller) increases during the day.
- The MPPT controller is the most sophisticated and efficient controller currently. This controller checks both the condition of the batteries and the potential of the panels. It constantly adjusts the panel voltage to get the most energy at all times (rain or shine).
- The hybrid controller can be a PWM as a MPPT. It is actually a controller that accepts two power sources to charge a single bank of batteries. The most common are hybrid controllers for solar panels and wind turbines. One advantage is that you have less wire and device to charge the batteries. A disadvantage is when the device breaks, all your charging sources stop charging the batteries.

Ⅳ. CONCLUSION :

If you are limited in space to add panels, using a MPPT controller will allow you to maximize your current panels. But if your group of solar panels is sufficient, at the end of the day, your batteries will be just as charged with a PWM even if it took an hour longer than with a MPPT.

If you use high-voltage panels or connect panels in series, the use of MPPT is not only essential but the only real choice; since the PWM will not only waste the excess but is often limited in the input voltage.

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