POWER QUALITY AND COST IMPROVEMENT BY PASSIVE POWER FILTERS SYNTHESIS USING ANT COLONY ALGORITHM.

[1]RACHID DEHINI. [2]SLIMANE SEFIANE.

[1] Assoc. Prof., Department of Electrical Engineering, Bechar University, Algeria

[2] Asstt Prof., Department of Commercial Sciences, University (center) of Relizane, Algeria

E-mail: dehinirachid@yahoo.fr , ssefiane@hotmail.com

ABSTRACT

The important problem of using passive filters remains in the determination of their sizes, which meets standard levels of harmonic distortion with the minimum of cost. Many multi-objective optimization methods aiming at reducing cost an Improving electrical power quality have been used. The purpose of this paper is therefore, to show the application of ANT COLONY OPTIMIZATION (ACO) to design the passive filters sizing worry in an electric network affected by harmonic disturbances. In this work, the objective function to be minimized is the value of current harmonic distortion and passive filters cost, these passive filters are simultaneously connected in parallel with (FAP) in load side in order to achieve the percentage of (SAPF) apparent power (SF) compared to (Load) apparent power (SL) Limited between 14% and 16% and become very reasonable. The studies have been accomplished using simulation with the MATLAB-Simulink. The results show That (SHAPF) is more effective than (SAPF), and has lower cost.

Keywords: *Passive Power Filter, Optimization, Ant Colony Optimization, Shunt Active Power Filter, Nonlinear Loads, Shunt Hybrid Active Filter.*

1. INTRODUCTION

Due to proliferation of power electronic equipment and nonlinear loads in power distribution systems, the problem of harmonic contamination and treatment take on great significance .These harmonics interfere with sensitive electronic equipment and cause undesired power losses in electrical equipment[1,2,3]. In order to solve and to regulate the permanent power quality problem introduce by this Current harmonics generated by nonlinear loads such as switching power factor correction converter, converter for variable speed AC motor drives and HVDC systems, the resonance passive filters (RPF) have been used; which are simple and low cost. However, the use of passive filter has many disadvantages, such as large size, tuning and risk of resonance problems which decrease more the flexibility and reliability of the filter devices.

Owing to the rapid improvement in power semiconductor device technology that makes high-speed, high-power switching devices such as power MOSFETs, MCTs, IGBTs , IGCTS, IEGTs etc. usable for the harmonic compensation modern power electronic technology, Active power filter (APF) have been considered as an effective solution for this issue, it has been widely used.

One of the most popular active filters is the Shunt Active Power Filter (SAPF) [5, 6, 7, 8, 9, and 10]. SAPF have been researched and developed, that they have gradually been recognized as a workable solution to the problems created by non-linear loads, unfortunately, because of the high cost operation, the (SAPF) is not a cost-effective solution.

The disadvantages of (RPF) and (SAPF) orientate the researchers toward shunt hybrid active power filter (SHAPF), consequently (SHAPF) has become more attractive [1]. The (SHAPF) involve a (RPF) connected in parallel with (SAPF), this solution allows the use of (SAPF) in the large power system avoiding the expensive initial cost and improves the compensation performance of passive filter remarkably.

The high cost and large capacity APFs, whereby form a very important role in determining the (SHAPF) performance, leads that the design of PPF is a major effect which influences the general (SHAPF) performance. It was noted that different approaches have been developed to optimize the passive filters sizes. Recently, to overcome this problem, some methods based on artificial intelligence have been applied. These methods generally do not require the convexity of the objective function and have a high probability to converge towards the global minimum.

The past decade has seen a dramatic increase in interest in ANT COLONY OPTIMIZATION (ACO) which is search algorithms using efficient operations found in nature for the determination of a function extreme defined on a data space. (ACO) have proven their effectiveness in the optimization of objective functions. In this work the application of (ACO) has been described to the problem of passive filters sizing in an electric network affected by harmonic disturbances. The minimization of total voltage and current harmonic distortion and cost of passive harmonic filters component has been used as objective function in order to achieve the percentage of (SAPF) apparent power (S_F) compared to (Load) apparent power (SL) Limited between 14% and 16% and become very reasonable.

The functioning of (SAPF) is to sense the load currents and extracts the harmonic component of the load current to produce a reference current Ir [14], a block diagram of the system is illustrated in Fig. 1. The reference current consists of the harmonic components of the load current which the active filter must supply. This reference current is fed through a controller and then the switching signal is generated to switch the power switching devices of the active filter such that the active filter will indeed produce the harmonics required by the load. Finally, the AC supply will only need to provide the fundamental component for the load, resulting in a low harmonic sinusoidal supply.

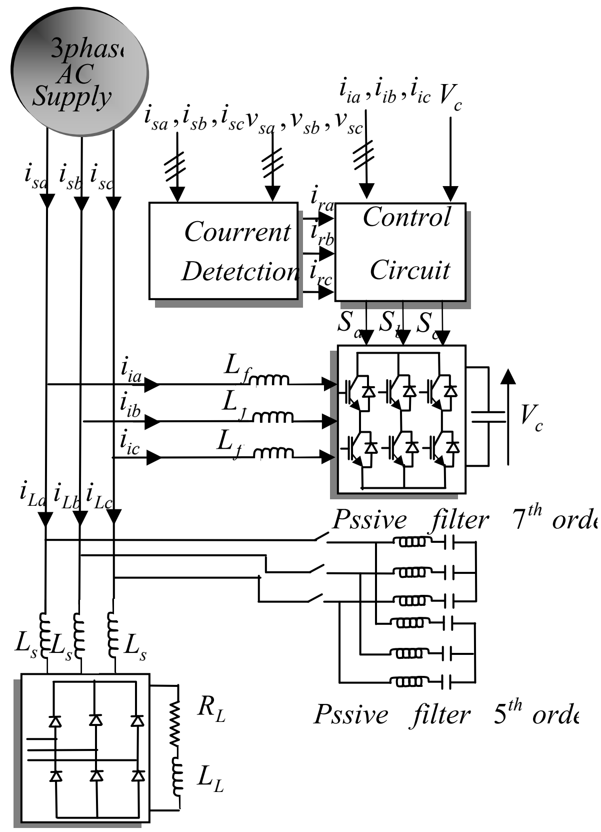

Figure 1.Schematic diagram of shunt (SHAPF)

2. MATHEMATICAL FORMULATION OF THE PROBLEM

The parallel passive filters were implemented since 1920, to compensate harmonics created by non linear loads, provide the reactive power requested, and increase the capacity of transport of networks. The basic shunt passive filtering principle is to trap harmonic currents in LC circuits, tuned up to the harmonic filtering frequency ,and be eliminated from power system.

In single-tuned filter, the reactance of inductor is equal to that of capacitor at resonant frequency f_n .The relationship among L, C, R, Q values are:

$$C_n = \frac{1}{L_n \bullet (2 \bullet \pi \bullet f_n)^2} \tag{1}$$

f_n is cut-off frequency

$$R_n = \frac{L_n \bullet (2 \bullet \pi \bullet f_n)}{Q} \tag{2}$$

where Q is the quality factor

After some calculations, it can lead

$$B_P = \frac{1}{Q} \tag{3}$$

where Bp is the bandwidth of the RPF

When Q is very high, the bandwidth is narrow, is difficult to obtain the turning up. Indeed, the inductance values and capacitance are given with manufacturing tolerance of rank ± 10%. Moreover, the capacity value varies depending on temperature. To overcome these drawbacks, we must take:

$Q \approx 75$ for inductors in air

$Q \succ 75$ for the iron core inductors

a) reactive power compensation

Reactive power compensation at 50 Hz is:

$$Q(w_0) = \frac{U^2}{|Z(w_0)|} = \frac{n^2}{n^2 - 1} C w_0 U^2 \tag{4}$$

n= harmonic order fn/f1

U= nominal line-line voltage

W0= $(2 \bullet \pi \bullet f_1)$ angular frequency

PPF expect a high Compensation reactive power in power system. But reactive power can't be overcompensation though $(\frac{S_F}{S_L} * 100)$ is limited between 14% and 16%.

Above need is expressed by:

$$Q_{\min} \le \sum Q_F \le Q_{\max} \tag{5}$$

After some calculations, it can lead

$$C_{\min} \le \sum \frac{n^2}{n^2 - 1} C_n \le C_{\max} \tag{6}$$

b) total harmonics distortion function

A suitable passive power filter shall have lower total harmonics distortion of current THDi which reflect harmonics suppression effect.

Let the equivalent 5th, 7th harmonic impedance of single-tuned filters are

$$Z_5 = R_5 + \frac{j}{C_5}\left(\frac{-24}{25 \ w}\right) \tag{7}$$

$$Z_7 = R_7 + \frac{j}{C_7}\left(\frac{-48}{49 \ w}\right) \tag{8}$$

The total impedance of system is introduced from above harmonic impedance, shown as

$$Z = \frac{Z_5 Z_7 Z_S}{Z_5 Z_7 + Z_S Z_7 + Z_5 Z_S} \tag{9}$$

Therefore, total harmonics distortion function of current is given by

$$THD_I = \sqrt{\sum_{j=5,7} \left(\frac{I_j}{I_1}\right)^2} * 100\% = \sqrt{\sum_{j=5,7} \left(\frac{Z}{kZ_j}\right)^2} * 100\% \tag{10}$$

c)cost function

The problem statement is to minimize multiple objective functions interpreting the cost of passive filters parameters and total current harmonic distortion associated with this nonlinear load. The objective function of the economic cost of Passive filters is presented as:

$$F(C, L, R) = a_1 \cdot C_i + a_2 L_i + a_3 R_i \tag{11}$$

Where a_{ji}, are the cost coefficients of each passive harmonic filter component.

According to resonate theory, resistor and inductor in formula (11) can be transformed into capacitor. So

$$F(C_i) = a_1 \cdot C_i + a_2 \frac{1}{w_i^2 C_i} + a_3 \frac{1}{w_i C_i Q} \tag{12}$$

The function to minimize can be described as follows:

$$\min\left\{\sum_{i=1}^{n} F(C_i) + THD_I\right\} \tag{13}$$

Under the following constraints:

$$C_5^{\min} \leq C_5 \leq C_5^{\max} \tag{14}$$

$$C_7^{\min} \leq C_7 \leq C_7^{\max} \tag{15}$$

3. THE ANT COLONIES OPTIMIZATION

The ant colony algorithm is a metaheuristic method used to solve difficult or combinatorial optimization problems. This algorithm is inspired from the ants' behavior using their individual substances, called pheromones, to open up their journey to the food source. When the ants explore the network, if an ant finds a good route, it reinforces the latter by a pheromones deposit. By this stigmergy mechanism, ants are able to bring out the shortest path between the nest and food sources. This algorithm, firstly proposed by Dorigo and his collaborators [15], has been successful and has given rise to large researches [17]. This approach applications to discrete optimization problems are numerous, e.g. the commercial traveler problem [15], the quadratic assignment, the sequential scheduling, the Vehicle routing, the routing in the telecommunication network, the graph coloring.

The ACO approach represents an optimization problem in a graph whose nodes and arcs represent the decision variables of the optimization problem. Ants build solutions step by step moving inside the graph according to a stochastic decision rule that depends on the one hand, the collective information derived from the environmental change, on the other hand, a heuristic value concerning the outgoing arcs choice quality. In the graph construction process, each ant does its next arc / node choice outgoing according to information stored in the graph, either the pheromone quantity or the heuristic value represent the local travel cost. The relative importance information's depend on the control parameters in transition rule. Once a journey is completed, information about the route quality will be changed. Whereas many algorithms based on the ACO are proposed, their schemes are similar and composed of three sequential steps: 1. initialization of a pheromone quantity, 2. a solution construction by the stochastic transition rule, 3. Update the pheromones quantity.

a) Step 1: Initialize a quantity of pheromone

The amount of pheromone components in the graph represents their attractiveness for guiding ants to find the better solutions in the search space. Most ACO algorithms initialize the graph components, with a small amount uniformly positive, i.e. between 0 and 1. However, one can use a feasible solution provided by another concurrent algorithm in order to favor certain journeys at the iteration beginning. Walkowiak [19] proposed an ant colony algorithm for solving the flow assignment problem under the flow capacity constraints of the section. In the algorithm proposed by Walkowiak, the pheromone quantities on all arcs are initiated by 1. Then it uses the updated formulas of pheromones traces in accordance with a feasible solution provided by another algorithm. Indeed, the initial pheromone amount does not play an important role in the optimal problem solution. Thus far, few researches have been devoted specifically to this subject.

b) Step 2: the solution Construction through a transition rule

The algorithm based on (ACO) uses information pheromone trails for finding gradually the optimal solution. This mechanism comes, on the one hand, local information that provide current information about environment, and on the other hand, global information based on the update pheromones traces to favour certain trails. The solution construction process, known as the graph construction is to cover the graph (arcs or nodes) step by step with a stochastic transition rule. The choice probability on the arc / node outgoing depends on the pheromone amount and local information on the arc / node outgoing. The transition rules must be adapted to each application problem. Other critical issues relate to the used configuration parameters, it takes time to test different configurations and achieve the good parameters configuration. Concerning the transition rule formulation, variants have been proposed of which the ants system algorithm (Ant System, (AS) [17] and the ant colony system algorithm (Ant Colony System ACS) [16] are the most common. These algorithms are described in details and the variations from both algorithms are analyzed in this work.

The ants' system algorithm (AS) is the first version of the ACO algorithm. As mentioned previously, the AS algorithm uses a transition rule for constructing the admissible solution. The transition rule is to guide each ant search direction towards the best solution. For the ant m located at node r, the choosing probability of the outgoing arc (r, s) at iteration t is defined by:

$$\begin{cases} P_{rs}^{m}(t) = \dfrac{[\tau_{rs}(t)]^{\alpha}[\eta_{rs}]^{\beta}}{\sum_{u \in j_r^m}\left([\tau_{rs}(t)]^{\alpha}[\eta_{rs}]^{\beta}\right)} & if\, s \in j_r^m \\ 0 & or\, else \end{cases} \quad (16)$$

Where:

α, β: Control parameters.

$\tau_{rs}(t)$: pheromone quantity on the arc (r, s) at t iteration.

η_{rs}: heuristic Value, called visibility, defined by the arc (r, s)length opposite, or the cost inverse on arc (r, s).

j_r^m: admissible nodes Set for the ant m at the summit r.

This transition rule gives the choosing probability of the next node to visit, according to the pheromone amount and local heuristic value. The parameters α and β control the relative importance of these two components. If α = 0 the ants choose the node with the best heuristic value. However, if β = 0, the probability choice depends only on the pheromones amount. As soon as an ant completes a trail, the pheromone trail is immediately reinforced. The amount of pheromone added depends on the quality of the path traversed.

c) Step 3: Update pheromone trails

The update of pheromone trails consists of two levels: the local updating and the global updating. The first is to immediately fill the pheromones depending on the solution quality found. The global update uses an evaporation coefficient rate $\rho \in [0,1]$ to reduce the pheromone density on all rails found. This mechanism aims to favour the exploration and to avoid stagnation in local optimum solutions. The pheromone update trails is expressed as follows:

$$\tau_{rs}(t+1) = (1-\rho)\tau_{rs}(t) + \rho \sum_{m=1}^{M} \left(\Delta\tau_{rs}^{m}(t)\right) \quad (17)$$

Where:

$\tau_{rs}(t)$: pheromone quantity on the arc (r, s) at iteration (t).

$\Delta\tau_{rs}^{m}(t)$: pheromone Amount added to the arc (r, s) by ant (m) at iteration (t).

ρ: Coefficient represents the pheromone evaporation rate.

M: total ants number

The update rule depends on application problem, e.g. ASrank method [20] reinforces the roads taking into account the best ants ranking. Max-Min AS [21] limits the amount of pheromone in the interval $\tau_{\min}$ *and* $\tau_{\max}$ to avoid the AS stagnation.

Theoretical works on the (ACO) method are concerned by the issues related, on one hand, to the algorithm convergence, on the other hand, to the transition rule permitted to have a more stable solution for the general problem of combinatorial optimization, because the pheromones amount plays an essential role on the (ACO) performance. As the (ACO) algorithm designer and his collaborator have mentioned, the same (ACO) algorithm achievement in two isomorphic problems (multiply a problem objective function by a constant), gives results and different behaviors.

For this, the following global update based on the relative entropy method is proposed by [18]:

$$\tau_{rs}(t) = (1-\rho)\tau_{rs}(t-1) + \rho \sum_{m \in M^{upd}}^{M} \left(\frac{\Delta\tau_{rs}^{m}}{\sum_{m \in M^{upd}}\left(\Delta\tau_{rs}^{m}\right)} \right) s(r,s) \in p^{m}(t) \quad (18)$$

Where: M^{upd} is the possible set of solutions generated at iteration (t). ρ is the rate of evaporation. $p^{m}(t)$ is the path taken by the ant (m) at iteration t.

This formula is to standardize the pheromone amount added to avoid the influence of the objective function order.

4. SIMULTION AND RESULTS

The performance of the (SHAPF) was examined through simulations. The system model was implanted in Matlab / Simulink environment. The (SAPF) was designed to compensate harmonics caused by nonlinear loads when the network is average relative to the load (Ssc / S_L = 300). The system model parameters are shown in Table 1.

Table .1 System parameters

Active Filter Parameters	
Supply phase voltage U	220 V
Supply frequency fs	50 Hz
Filter inductor Lf	0.7 mH
Dc link capacitor Cf	0.768474 mF
Smoothing inductor Lsmooth	70 µH

A three-phase diode rectifier with an RL load was used as a harmonic producing load. The load (resistance was 10/3 Ω and the inductance 60 mH.).

The (ACO) which provides optimization of PPF is used only during the (PPF) synthesis phase. It is no longer involved in the system during normal operation.

The main parameters chosen for (ACO) are shown in Table 2:

Table .2.The (ACO) values parameters.

Ant Number	10
Maximum Cycle Time	100
Initial Value of Nodes Trail Intensity	0.1
Coefficient ρ	0. 5
(α) Control parameterof Trail Intensity	1.5
(β) Control parameter of Visibility	5
Unit price of R	a3=88¥/Ωµ
Unit price of C	a1=4800¥/µF
Unit price of L	a2=320¥/mH
Bound of C5	[125 , 190]
Bound of C7	[43.2 , 108]

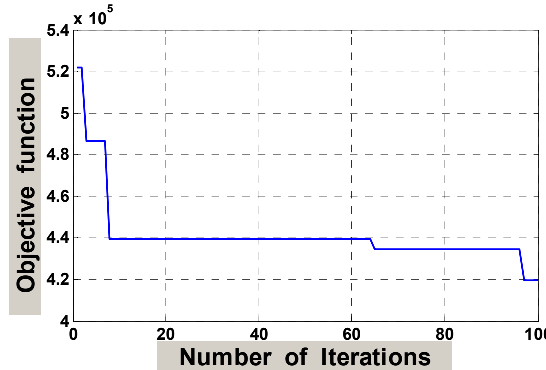

Figure 2.varition of objective function according to the number of iterations

Table.3. the optimum Passive filters characteristics

order	5 th	7 th
R(Ω)	0.0251851	0.0461814
L(mH)v	48.1	63
C(µF)	189.2361	103.1286
THD_I (%)	0.72%	
THD_V (%)	0.30%	
QC(VAR)	8942.312	4775.8538
Cost(¥)	4.1955e+005	

The waveform and spectrum character of phase-a supply current is presented in Fig. 13 ,system without (SAPF), then the total harmonic distortion has been taken up to 2.5 kHz (THD2,5 kHz)

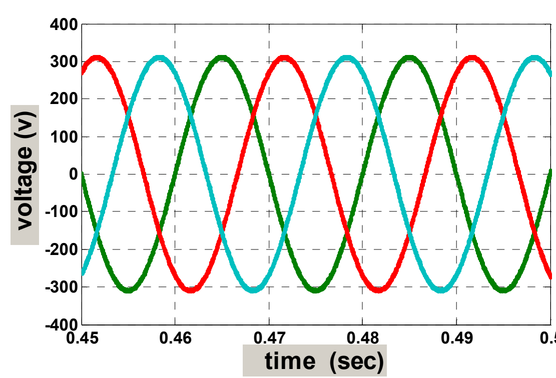

Figure.3. Simulated supply voltage waveform.

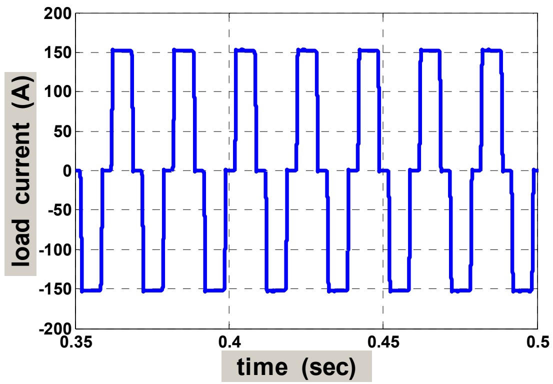

Figure.4. Simulated phase-a- load current.

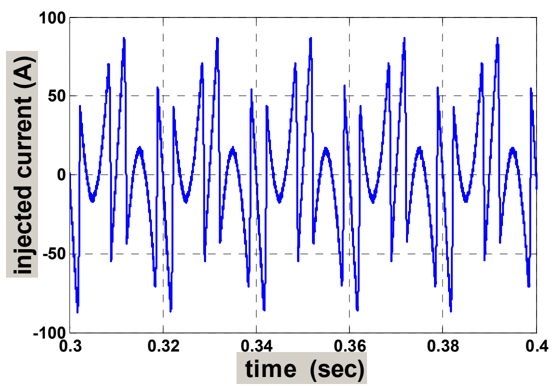

Figure.5. Simulated phase-a-the injected current waveforms with (SAPF).

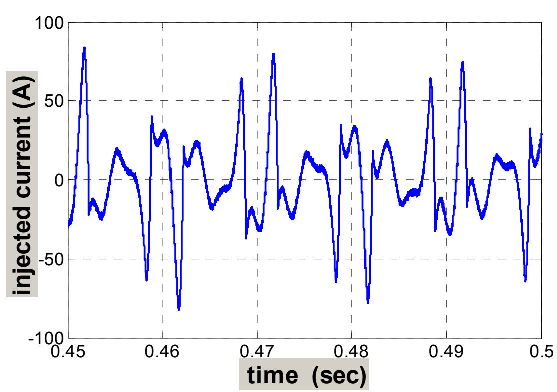

Figure.6. Simulated phase-a the injected current waveforms with (SHAPF)

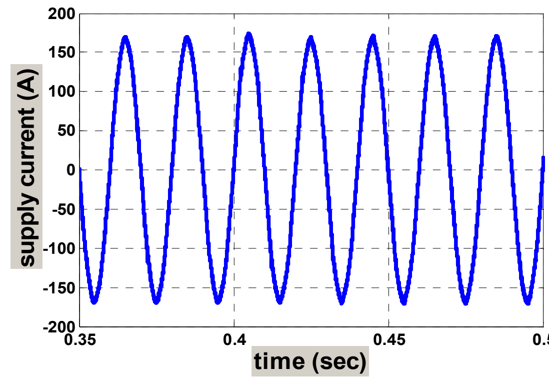

Figure.7. Simulated phase-a-the supply current waveforms.

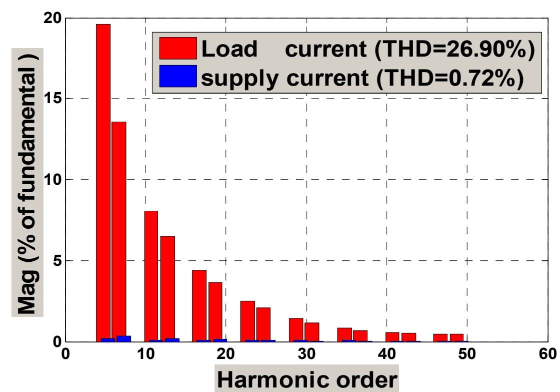

Figure.8. Harmonic spectrum of supply current and load current Phase -a-.

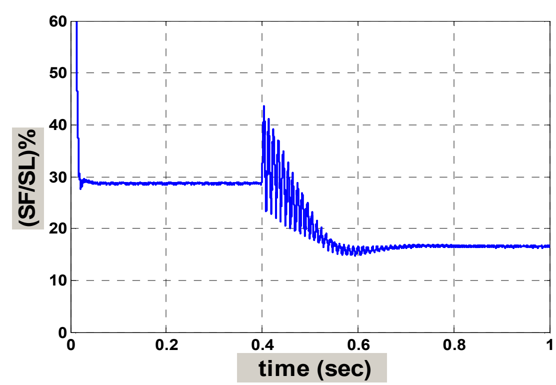

Figure.9. percentage of (SAPF) apparent power compared to (Load) apparent power

5. DISCUSSIONS:

•The RPF (h5 + h7) has further improved the functioning of the (SAPF) figure (8) and declined further its power figure (9).

• According to Table (3), there is a remarkable improvement THD_V (0.30%)

• According to figure (7) and figure (8), there is a remarkable improvement THD_I (0.72%)

• The 5th and 7th harmonics are not completely eliminated but they are strongly attenuated figure (8).

• According to figure.9. the percentage of (SAPF) apparent power (SF) compared to (Load) apparent power (SL) has declined from 28.83% to 16.54%) and has become very reasonable.

According to simulation results obtained in this work, we can say that the (RPF) can be an effective solution for the harmonic currents compensation for power network (relative to the load) with a risk of parallel resonance. The (SAPF) presents the ideal solution for currents harmonics compensation regardless of the power network, but this solution is costly. The (SHAPF) justified its use by reducing the apparent power of the used (SAPF) and improving its operation.

6. CONCLUSIONS

This paper presents the development of flexibility and reliability of the filter device by coming together the advantages of power passive filters (PPF) and Shunt Active Power Filter (SAPF) for leaving behind their drawbacks. A (SHAPF) is adopted in order to achieve the harmonics and reactive power compensation. The well adjusted (SHAPF) rests on passive filter designed. In this work by using ANT COLONY OPTIMIZATION (ACO), sizing of passive filters is determined with larger rated power to filter the low order harmonics, they are simultaneously connected in parallel with (FAP), the later has low power rating and reserved to filter the other high order harmonics. Measured up to (SAPF), the (SHAPF) can decrease the power rating of active part. Both the compensation performance and the parallel resonance damping can be improved by the later compared with power passive filters (PPF) used only and (SAPF). From the comparative analysis, hybrid filter is effective and economic for solving nonlinear load problems.

REFERENCES:

[1] Xi. Z., Fang, Z., Rui. D., Wanjun. L., Pengbo. Z., Zhaoan. W. "Development of a Parallel Hybrid Power Filter with Respective Harmonic Compensation Method", 0-7803-9547-6/06/$20.00. ©2006 IEEE, 2006, pp. 1733–1737.

[2] Rahmani.S., Hamadi. A., Mendalek. N., Al-Haddad. K., "A New Control Technique for Three-Phase Shunt Hybrid Power Filter", (c) 2009 IEEE, 2009,

[3] Wu. J. , He. N., Xu. D., "A 10KV Shunt Hybrid Active Filter for a Power Distribution System", 978-1-4244-1874-9/08/$25.00 ©2008 IEEE, 2008, pp. 927–932.

[4] Abdelmadjid. C., .Jean-Paul G., .Fateh K., . Laurent. R., "On the Design of Shunt Active Filter for Improving Power Quality", Title of the article, 978-1-4244-1666-0/08/$25.00 '2008 IEEE, 2008,

[5] Tavakoli Bina. M. , Pashajavid. E., "An efficient procedure to design passive LCL-filters for active power filters", © 2008 Elsevier B.V, 2008, doi 10.1016/j. epsr. 2008.08.014, pp. 606– 614.

[6] Adel M. A.,David A. T., "A Three-phase Hybrid Series PassiveBhunt Active Filter System", 0-7803-5160-6/99/$10.00 0 IEEE., 1999, pp. 875– 881.

[7] He. N., Wu. J., Xu. D., "A Novel Shunt hybrid Power Filter for Suppressing Harmonics", IEEE ISIE 2006, July 9-12, 2006, Montreal, Quebec, Canada, 2006, pp. 1155– 1160.

[8] Salem. R., Kamal. A., Hadi Y. K., A "comparative study of shunt hybrid and shunt active power filters for single-phase applications: Simulation and experimental validation", 0378-4754/$32.00 © 2006 Published by Elsevier B.V. on behalf of IMACS. doi:10.1016/j. matcom. 2006.02.018, pp. 345– 359.

[9] Huann.K.C., Bor.R.L., Kai. Y., Kuan.W.W. "Hybrid Active Power Filter for power quality compensation", 0-7803-9296-

5/05/$20.00 C 2005 IEEE., 2005, pp. 949–954.

[10] Yi.n. G., Juan. Z., Jian. C., Xing.d. J., “Optimal Design of Passive Power Filters Based on Knowledge-based Chaotic Evolutionary Algorithm”, 978-0-7695-3304-9/08 $25.00 © 2008, 2008, DOI10.1109/ICNC.2008.899.,pp. 535– 539.

[11] Taruna. J., Shailendra. J., Ganga. A., “COMPARISON OF TOPOLOGIES OF HYBRID ACTIVE POWER FILTER”, IET-UK International Conference on Information and Communication Technology in Electrical Sciences (ICTES 2007), Dec. 20-22, 2007.,pp. 503– 509.

[12] Hurng.L. J., Jinn.C. W., Yao.J. C.,Ya.T. F.,A “Novel Shunt Hybrid Power Filter for Suppressing Harmonics”, IEEE TRANSACTIONS ON POWER DELIVERY, VOL. 20, NO. 2, APRIL 2005, pp.1507–1513.

[13] Ruixiang. F., Min. S., An. L., Zhikang. S., “Configuration of A Novel Hybrid Active Power Filter and its control method”, 978-1-4244-2487-0/09/$25.00 ©2009 IEEE .

[14] H.Akagi,Y.Kazanawa and A.Nabae, ‘‘Instantaneous reactive power compensator copresing switching Devices without energy storage components’’ , IEEE Trans. power Ind.Appl., vol. IA-20, n° 3,pp:625-630,1984..

[15] Dorigo, M., Maniezzo, V., Colorni. A. Positive feedback as a search strategy. Technical Report, 91-016, Dipartimento di Elettronica, Politecnico di Milano, IT, 1991.

[16] Dorigo, M., Gambardella, L.M. Ant Colony System: A Cooperative Learning Approach to the Traveling Salesman Problem. IEEE Transactions on Evolutionary Computation, vol. 1(1), 1997, p.53-66.

[17] Dorigo M., DI Caro, G., Gambardella, L.M. Ant Algorithms for Discrete Optimization. Artificial life, vol. 5(2), 1999, p.137-172.

[18] Dorigo, M., Blum. C. Ant colony optimization theory: A survey. Theoretical computer science, vol. 344(2-3), 2005, p.243-278.

[19] WALKOWIAK, K. ANT ALGORITHM FOR FLOW ASSIGNMENT IN CONNECTION-ORIENTED NETWORKS. APPLICATION MATHEMATICAL COMPUTATION SCIENCE, VOL. 15(2), 2005, P.205-220.

[20] Bullnheimer, B., Hartl, R.F., STRAUSs, c. An Improved Ant System Algorithm For The Vehicle Routing Problem. technical report, pom-10/97, institute of management science, university of vienna, 1997.

[21] Stutzle, T., Hoos, H. Max-Min Ant System And Local Search For The Traveling Salesman Problem. In: Proc. of Evolutionary Computation, IEEE International Conference, 1997.

AUTHOR PROFILES:

R.Dehini: received his Bachelor degree in electrical engineering from the National High School for Technical Teachings (ENSET), Algeria in 1994 and his M.S.degree from Bechar University, Algeria in 2008. He is currently studying for the Doctorate degree. His area of interest is electrical power quality and artificial intelligence.

Dr. S. Sefiane, is currently working for Relizane, university; Algeria as an associate professor of accounting and Finance at the institute of economics and commercial sciences, he holds a PhD degree from UK in 1991. His area of interests is in cost accounting and finance.