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A Case Study of Substance Field Analysis and Resource Analysis; Development of New Mosquito Traps

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Abstract

New mosquito traps were developed by substance-field analysis and resource analysis. At the concept development the useful and harmful relationship between mosquito and human was modeled by substance field model and resolved by one standard. The resource analysis and technology forecasting stimulated to generate the new mosquito traps by using the photo catalysis, TiO_2 (titanium dioxide). The new traps implemented catch over 10 thousands a one night near cattle shed in Korea, in summer.

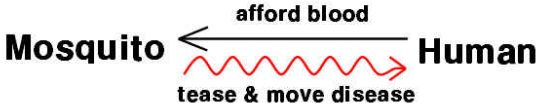
Key words: TRIZ, Su-Field Analysis, Resource Analysis, Mosquito Trap, Photo catalysis, Ideality

1. Finding the problem related to mosquito

Summer in Korea is hot and humid like Italy. There are so many mosquitoes. Specially, the summer in 1998 was so hot with high humidity. At that time I with our undergraduate students at Korea Polytechnic University thought that who invents the method to protect mosquitoes from human may make big money.

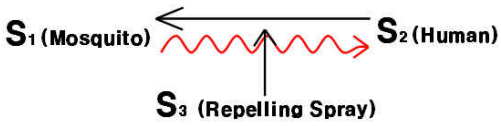
2. Su-field modeling for mosquito problems and the conventional remedies

The fall in 1998, we tried to model the problem related to mosquito by using Su-field modeling in TRIZ. For the conventional methods to protect mosquitoes biting human, we drew the Su-field diagrams. Specially, for repelling spray ("DEET") the Su-field modeling was as follows;



The repelling spray on human body is not sufficiently effective and harmful to human body a little. It is

one extra substance S_3 between mosquito S_1 and Human S_2 in Su-field model as follows;



In the problem above, all kinds of methods against mosquito are complete yet.
By using one standard solution in TRIZ, the S_3 (the third substance) is recommended by the substance modified from S_1 and S_2.

The S_3 may be imaged as substance modified from S_1 (mosquito) or from S_2 (human).
The idea on system like artificial human (S_3) seducing more mosquitoes than real human, might be generated easily from that the S_3 is the substance modified from the S_2 (human).

So the system would be the mosquito trap. The S_3, mosquito trap protects mosquitoes against going to human.

At that time we got the initial conceptual idea for mosquito trap as an artificial human to seducing the mosquitoes more than real human.

The ideality of the mosquito trap may be written down as follows;

$$\text{Ideality} = \frac{\text{Functionality}}{\text{Cost + Harmful}} = \frac{\text{Capability to seduce mosquitoes more}}{\text{Cost of System + Other Harmful functions}}$$

On capability to seduce mosquitoes more, we get the advise from some experts related to mosquitoes at Korea NIH.

3. New mosquito trap with photo catalysis TiO_2 based on the ideality concept

Most mosquitoes like the CO_2 (Carbon dioxide) gas very much. To generate CO_2 gas cost effectively is very difficult besides CO_2 or propane gas bottles with high pressure.

We investigated the many methods to get the CO_2 cost effectively with other good functionality and low cost with little harmful function based on the ideality concept.

We found the mosquito trap using ultra violet light lamp with suction motor fan for catching some mosquitoes. Through the directional search for methods to generate the CO_2, we knew that the photo catalysis material, TiO_2 (Titanium dioxide) generates CO_2 after purifying airs by OH- (Hydrogen oxide radical) generated by ultra violet lamp as the source of the photo catalysis.

The process to generate the CO_2 is as follows;

1) The UV light as the source of photo catalysis, onto the TiO_2 surface generates much OH-.
2) The much OH- purifies the dirty air with smell and organics including carbon.
3) The by-products from the purifying are CO_2 + H_2O (water vapor).
4) Both CO_2 and H_2O are some attractants for mosquitoes.

So we modified the initial idea with mosquito trap by the new traps using photo catalysis TiO_2 with ultra violet lamp.

The ideality was increased as follows:

$$\text{Ideality of new trap} = \frac{\text{higher capability to seduce mosquitoes + air purification}}{\text{A little cost up (for } TiO_2 \text{ coating) + no harmful function}}$$

The structure of the new mosquito traps is below schematically and was pended as the patent internationally (the number of patent is PCT/KR/01-00427). The prototype was made and evaluated as an invention with bronze medal in one of German international invention completion, IENA 2000 in Nurnberg, Germany. The new traps implemented catch over 10 thousands a one night near cattle shed in Korea, in summer. The prototype was commercialized and the products are being exported to the world such as U.S.A and Europe including Italy.

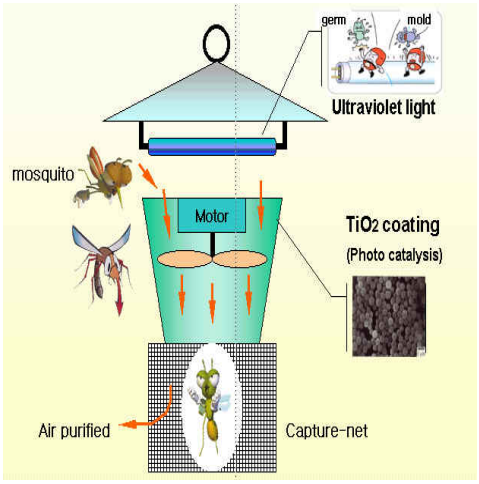


Figure for principle of new mosquito trap

Product

4. Development of recent new mosquito trap through resource analysis and ideality concept

Meantime, some customers of the new mosquito trap complained the burden to clean up the cylindrical capture-net with numerous mosquitoes captured every morning and the suction power is not

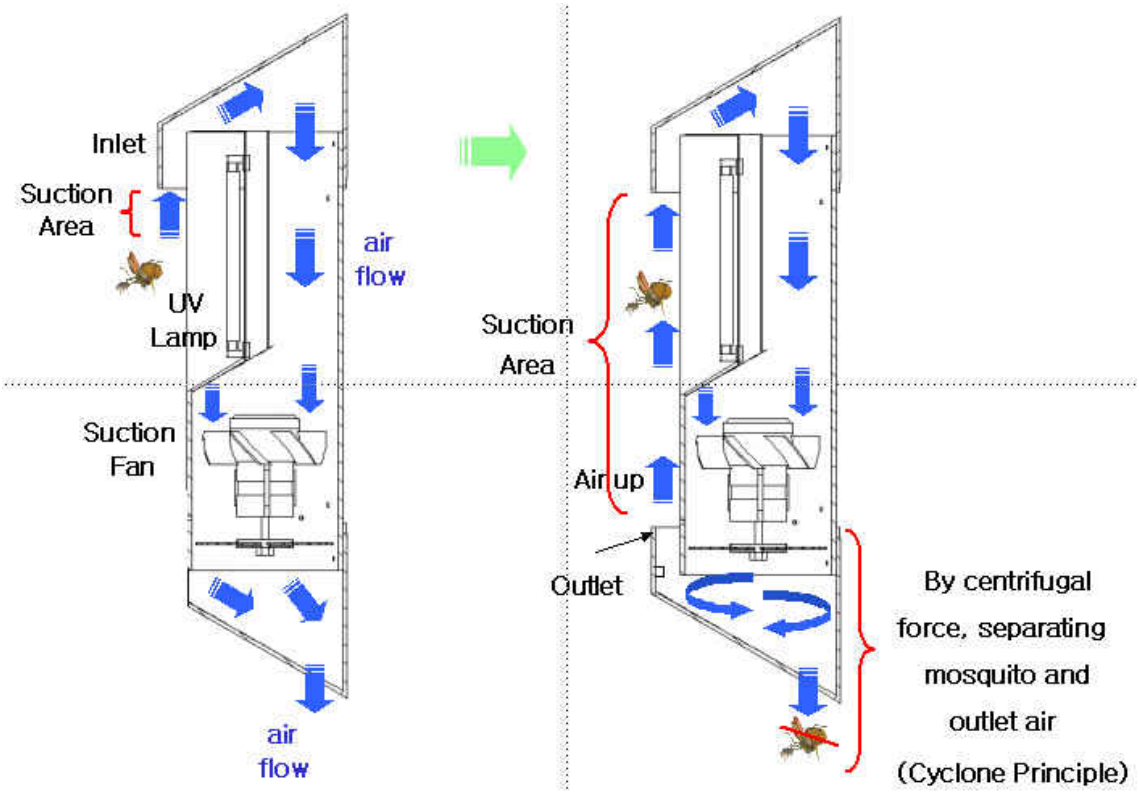
powerful.

We designed the recent new mosquito traps as shown in the figure below through resource analysis.

The power suctioning the inlet air is too low and the burden to clean up the numerous mosquitoes captured over night, may be eliminated for some customers to manage the traps everyday.

Through the resource analysis of the new designed mosquito trap, the outlet air from the trap was not used and discarded. We decided to guide the outlet air up to inlet for empowering the suctioning power.

In addition, for the automatic cleaning up, we devised the cyclon principle with centrifugal force generated by rotating motor and fan. That is, the centrifugal force separates the mosquitoes captured and outlet air. The outlet air is guided up for empowering the suctioning power at inlet and the mosquitoes fall down automatically by gravitational force as shown in figure.



$$\text{Increased Ideality} = \frac{\text{more higher capability for mosquitoes + air purification + automatic clean up}}{\text{a little cost up (for } TiO_2 \text{ coating + extra simple structure) + no harmful function}}$$

Hence the concept and products on the hand-free and clean-up free excellent mosquito traps were

generated and implemented.

Prototype of recent new mosquito trap and the figure attached pole of street lamp

5. Conclusions

The new and recent hand-free mosquito trap and the products were invented using the Su-field analysis and resource analysis based on the ideality concept. Also, we can conform that every (technical) system has evolved to the new system based on higher ideality. Through the products and its development process, TRIZ was conformed as a powerful tool to generate new innovative ideas. We hope that our concepts and products would be one excellent remedy to eliminate mosquitoes efficiently, specially, environment friendly.

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