# Final Report

## on

## Emergency Action for East Timor Refugees

December 1999

Yayasan Dian Desa

a

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# Final Report
# on
# Emergency Action for East Timor Refugees

*In July 1999 USAID team visited East Timor refugees in several sites in Kabupaten Belu (the closest district at the border between East and West Timor) Based on their observation and analysis several problems which need immediate action were identified One of them is water and sanitation action in order to avoid humanitarian disaster*

*USAID has approached and contacted several USAID s partner organisations looking for possible cooperations in order to overcome that identified problems One of them is Yayasan Dian Desa (YDD) which is assigned to manage activities related to the provision of water system and sanitationfacilities in several identified refugee s settlement areas*

*This report of respective undertaking which include achievements and problems faced in the field is presented below*

## A Background

The ballot in East Timor was conducted in August 1999 and this is an important venue in order to determine the future of East Timor
Dispatchment of UNAMET team (United Nations mission in East Timor) was started in last May to prepare and develop a conducive situation for that ballot
At that time there were two political fractions in East Timor those who want the integration with Indonesia which is referred to as 'Pro Integration group and those who want independence which is referred to as "Pro Independence group"
And in the middle there is a mass of common people who actually did not fully understand the politic and like usual they become the victims of friction between those two groups

Since many years ago, frictions between those two groups which oftenly lead into open clashes were very common Therefore there was a prediction that prior and after the ballot the intensity of that friction will substantially increase As a result there was a general consensus that greater violence and displacement will result on the increasing number of refugees approximately 25,000 – 100,000 Most of them move to West Timor (Kab Belu, the closest district at the border)

The announcement of the ballot result was done in September 4$^{th}$ 1999 (faster than anticipated) and the so called "pro independence" win the vote This has led into a totally uncontrolable situation The so called pro integration group (especially the militia) became so brutal and killing, burning robbing and raping became the common picture
In other words the real situation is much worse compare than the general anticipation mentioned above The influx of refugees is much higher than anticipated
On top of that the process of "vendetta" was continued even in many refugees settlements and this lead into an unconducive condition especially in conducting emergency action Level of suspect and frustration lead into very low solidarity among the refugees Besides that many provocations were made by various parties which makes reconciliation process become so difficult and complex

Thus the process of developing water and sanitation systems in the field (in the context of Action for East Timor Refugees) was conducted in the middle of such dynamic and complexity

## B Implementation Dynamic Original Plan *vs* Reality and Achievement

The original plan for the provision of water and sanitation systems (WSS) for East Timor refugees was done by the USAID team in July 1999 This include the selection of sites and amount of systems to be constructed
At that time there were only small amount of refugees and therefore the selection of sites was done based on anticipation and input from local authority
However when the peak of refugee's arrival happen (september 1999) that anticipation is not anymore valid Due to various reasons such as security, potential conflict with indigenous population vendetta among refugees, etc, some changes need to be done

In general the comparisan between original plan and realization is as follows

### B 1 Sites of WSS

The original sites identified by USAID team were

| No | Name of Location | Sub District | District | |
|---|---|---|---|---|
| 1 | Terminal Lolowa | Atambua | Belu | Near the bus terminal of Atambua |
| 2 | Fatubenau Market | Atambua | Belu | Near the market of Fatubenau |
| 3 | Desa Dualaos | Tasifeto Timur | Belu | Close to the border in north part of Belu where in the beginning become a refugees concentration who came from north region of East Timor |
| 4 | Desa Alas | Kobalima | Belu | Close to the border in the south part of Belu and in the beginning become refugees concentration who came from south region of East Timor (Suai Ermera Ainaro Ailiu etc) |

Changes of sites in the implementation and rationale behind are as follow

- Terminal Lolowa — as planned
- Fatubenau market — In the beginning it was OK when the amount of refugees was moderate Later there were too many frictions between the refugees and indigenous population Especially because that place is the center of economic activities and easy to create jealousy Therefore in order to reduce this tension the district authority move the location to Haliwen (known as stadion mini Haliwen) Consequently the WSS constructed is also moved to Haliwen in order to avoid idle and/or unutilized construction
- Desa Dualaos — Located close to the border in sub district of Tasifeto Timur In September 99 many open clashed in that area and level of security become so serious In order to survive the refugees in that location move further closer to Atambua city and that location become empty In the beginning some move to stadion mini Haliwen mentioned above But here they are not safe also because majority of east timor refugees in Haliwen are militia or ex militia who are so cruel Therefore they are moved to desa Tenukiik and place near the military camp Thus the WSS is constructed in desa Tenukiik
- Desa Alas — Similar to desa Dualaos East Timor refugees who in the beginning settled in desa Alas have to move further to dusun Raihenek which are bit far from the border but still in the same subdistrict Even the indigenous population of desa Alas have to move also to other place because their village is not safe
  Note this desa is the burial of victims of massacre in Suai and found in december 99

☛ *Changing of sites has been communicated to USAID through email (see our email)*

Therefore the project sites become as follow

| No | Original | Moved to |
|---|---|---|
| 1 | Terminal Lolowa | Terminal Lolowa |
| 2 | Fatubenau Market | Haliwen |
| 3 | Desa Dualaos | Desa Tenukiik |
| 4 | Desa Alas | Desa Raihenek |

## B 2 Source of Water

In the context of water and sanitation the availability of water become the most important issue Water availability in those locations (and West Timor in general) is very scarce and even insufficient for indigenous population especially in dry season

Deep groundwater is the only possibility and during USAID mission in July '99 there was an information from the local public work office that the depth of groundwater aquifer is approximately 60 meters
On other hand it was impossible to conduct a detail ground water survey (such as geo-electrical test and other measures) due to time limitation Moreover the flow of refugees was increasing rapidly and cannot wait
In other words risk taking action is needed and USAID decided to take that risk financially

Therefore the mandate provided by USAID to YDD are

- To make four units of deep well up to approximately 60 meters, install the power generating and pumping system needed in each site include all piping & storage system to serve the refugees in each selected site The size of storage system is 12 m3
- To make 4 sanitation systems and each system consist of 3 compounds and one compound has 5 units of toilet
- To introduce Solar disinfection technology which enable the refugees (especially women) to produce potable water without boiling, since firewood is very scarce and other types of fuel (kerosene) is expensive and beyond the reach of respective refugees

In the case that no water aquifer at that depth, YDD will try to find solution by moving the drilling rig to other site nearby and make other well as far as the overall expenditure is still within the total approved budget
In other words the limiting factor is the total amount of USAID approved budget

## B 3 Implementation and Achievements

The agreement from USAID was received in August 1999
However based on oral notice of proceed from USAID the preparation was started on August 8th 1999 The first step was the mobilisation of personels drilling rigs and other basic equipments & materials
Other important preparation in drilling operation is the provision of water Since there is not adequate water in respective sites water for drilling must be

transported from nearby river In this case special truck with water tank must be available to supply the water for the drilling operation
The drilling was started in the third week of August 1999 and the result of each activity component is as follows

**Water Supply System**

a **Site 1 Terminal Lolowa**

Drilling was started in the third week of August 1999 and in the first week of September 1999, it had achieved minus 44 mtrs
Process from minus 44 meters below was slow because we found hard rock formation in in about ten days it had reached minus 62 meters
Passing this hard rock formation we found dry layer and total water loss occured which may drain the water from the upper layer to this dry & poreous formation Consequently we had to seal it at minus 60 meters and try to utilize water from upper layer (referred to as upper ground water)
But the discharge of from this upper layer (the water table is -4 mtrs) is small and cannot be exploited using the power generated deep well pump
Based on the testing, the exploitable discharge is only approximately 0 35 liter/sec Thus it can be exploited by using handpump only

To find other alternative, we try to find other site nearby (located app 250 meters from the first one) and conduct drilling for the second well
In this second location we drilled up to minus 78 meters But the result is even worse compare than the first one and after the testing the water discharge is too small and even cannot be exploited

Thus in the Terminal Lolowa we have drilled two wells and only one of them can be utilised However the discharge is low and can be utilised by using handpump only

b **Site 2 Haliwen (Stadion Mini)**

Technically the drilling and construction of deep well in this site did not face any serious problem The aquifer was found in minus 48 meters and the recharge capacity at minus 60 meters was good
Drilling was stopped as minus 62 meters Gravel pack and screen were installed at minus 55 mtrs up to minus 61 mtrs
After the construction testing was conducted and the exploitable discharge is approximately 5 8 ltrs/sec

The non technical problem was the fact that development of water and sanitation system in this site was started in mid September 1999 Because we have to wait other drilling unit sent from Yogyakarta The original plan was to finalise the drilling in Terminal Lolowa and after that use the machine to conduct drilling in Haliwen But the work in Terminal Lolowa was delayed due to problem described above and therefore additional drilling unit need to be made available
In September 1999 there was the peak influx of refugees and majority of refugees placed in Haliwen Stadion Mini were the militia-background They were so frustrated, incooperative and oftenly performed various types of uncontrol behaviour
In Haliwen one of staff accidently got shot and must be hospitalized

In spite of that non technical problems above, the work in Haliwen Stadion Mini was accomplished in the first week of October 1999 The local district government is very cooperative and they provide maximum support such as truck to tranport water for drilling and spooling Besides that in order to expand the distribution outreach additional fiberglass tanks and distribution pipes were also provided

c **Site 3 Desa Tenukiik**
As mentioned above, originally local district government did not plan Tenukiik as one of refugee's settlement Since many refugee s settlements in the north part of Belu (Dualaos and Atapupu areas) became unsafe, many refugees move closer to Atambua city and Tenukiik was decided as site to place them

Technically the drilling and construction of deep well in this area did not find any serious problem Aquifer is found in the minus 47 meters and exploitable water discharge is approximately 4 5 ltr/sec

d **Site 4 Desa Raihenek**
Like Terminal Lolowa, the drilling in Raihenek was started in the third week of August 1999 The drilling of the first well was done until minus 69 meters but is not successful At minus 38 until 52 meters blue clay layers was found and below that layer no water aquifer found

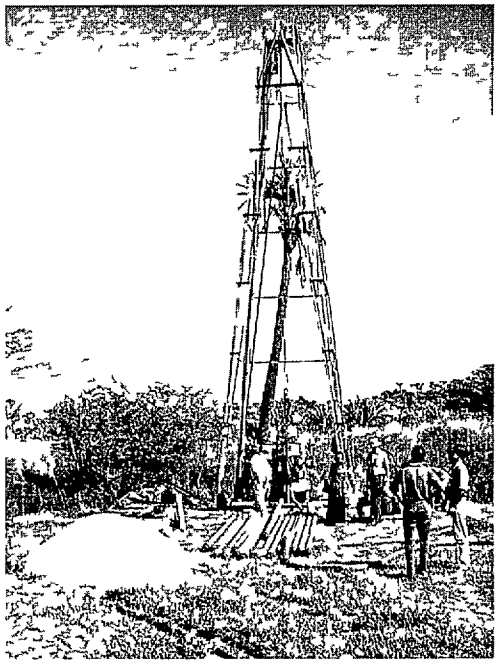
Therefore we identify several other sites and determine one of them to be drilled as second trial (about 220 meters from the first one)
The second trial is successful and water aquifer is found at minus 57 meters and the drilling was done up to minus 64 meters The pressure of that aquifer is also good and the water table reach minus 5 meters Thus the submersible pump is placed at minus 45 meters
Based on the testing the exploitable discharge is at least 8 ltr/sec

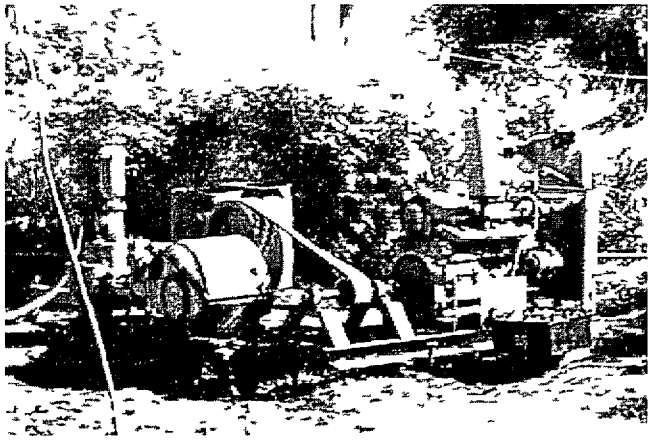
In this site we receive a valuable support from local church Especially father Siprianus who assist us in identifying the appropriate well site and provide moral support to refugees which lead into a good and cooperative climate

Summary of constructed well and drilling is as follows

| No | Location | Total of well drilled | | Result |
|---|---|---|---|---|
| | | Amount | Well | |
| 1 | Terminal Lolowa | 2 | Well 1 | Not successful exploitable discharge is enough for handpump only |
| | | | Well 2 | Not successful no water aquifer |
| 2 | Haliwen | 1 | Well 1 | Successful exploitable discharge is approximately 5 8 ltr/sec |
| 3 | Desa Tenukiik | 1 | Well 1 | Successful exploitable discharge is approximately 4 5 ltr/sec |
| 4 | Desa Raihenek | 2 | Well 1 | Not successful no water aquifer |
| | | | Well 2 | Successful exploitable discharge is approximately 8 ltr/sec |
| Total | | 6 | | |

Mobilization of drilling rig in Raihenek (left) and drilling process in Lolowa (right)





The mud piston pump which consume lot of water for spooling process (above)
The construction of gravel pack to secure the good recharging capacity (left)

## Power, Storage and Water Points

a **Power** Diesel engine and alternator are used to generate power for water pumping In this case operation and maintenance of that power generator become the key factor in securing the water availability

Therefore the availability of local backup is important in determining the type and/or brand of engine to be used Based on the advice from local private sector Mitsubishi diesel is the most appropriate Because in reality this type of engine is commonly used for local transportation (known as Colt diesel) and consequently many local mechanics are used to handle & repair such engine Assembling of power generator (include it's electrical panel) was done in YDD workshop in Yogyakarta and altogether shipped to Timor in second first of September 1999

Capacity of each engine is 78 HP and the production capacity of each alternator installed is 15 KvA Although the pump need only 4 5 KvA but

we decide to install higher capacity Especially based on assumption that later (after the situation in the refugee's settlement is more settle and organized) there will be a need for power such as for health activity lighting, etc

At that time no need to purchase new power generator since the excess power from this WSS system can be utilised for those purposes

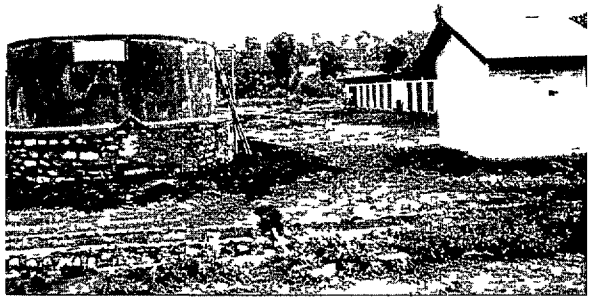
b **Storage & Water Points** According to the original plan the size of storage in each location is 12 m3

However in reality we observe that the water is not only used by the refugees in respective settlement Many water trucks take water from this project and transport it to other settlements which still do not have water facility Therefore the planned storage capacity is not sufficient to answer such reality and the only way is to increase the storage capacity

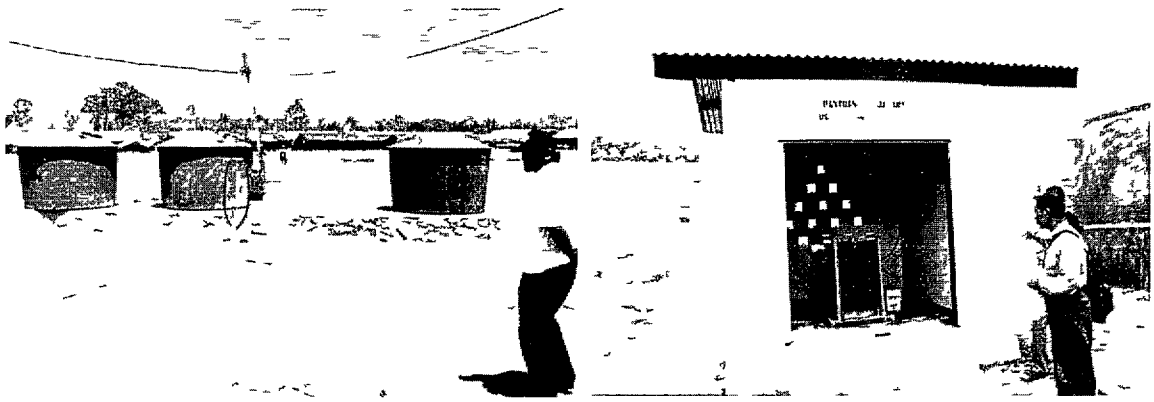
Taking into account the ceiling of approved budget from USAID, YDD decided to construct 40 m3 storage instead of 12 m3

Nothing special with the water distribution points

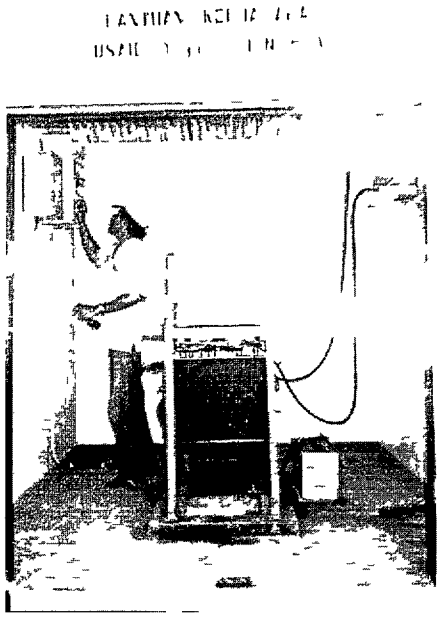
Storage reservoir in Haliwen Stadion Mini under the construction (left) During finalisation and curing process the volume is 45 m3 (right)



Unit in Raihenek storage reservoir on the left and toilet & washing facilities and power house on the right (left)



In Haliwen from the storage reservoir water is distributed further to many sub settlements piping system is from the project and additional fiberglass tanks with 2m3 each are provided by local district government (above left) Power house where power generator and electrical pumping panel are placed (above right)



Guidance to operate and maintain the power system (right) and visit of USAID team and local authority duringthe construction (above)

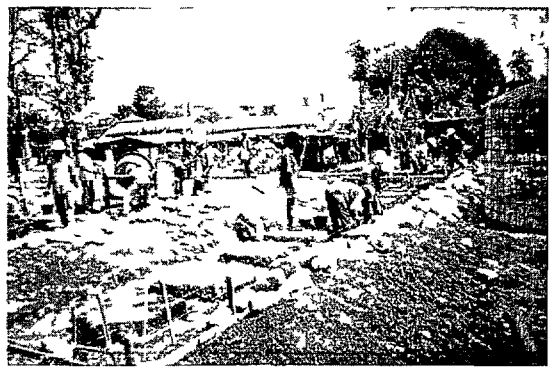
Water is a basic need and refugees cannot wait Even before the all constructions are finalised partial flow of water just to answer the need (above left & right)

## Sanitation Facility

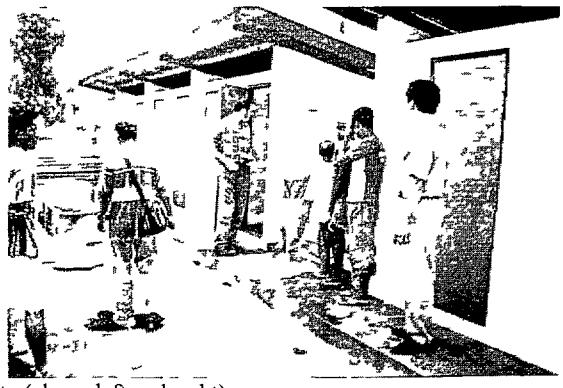
Sanitation facilities in all sites are implemented as planned Facility in each site consist of 3 compound, and one compound consist of 5 sets of toilet and washing/bathing facilities
Each compound is equipped with underground septic tank and percolation ditch to secure a good sanitation condition

In the beginning there were suggestions from local authority to just make simpler sanitation facility such as simple pit (referred to as "Cubluk") The argument was the assumption that refugees will only be there temporarily
But on other hand nobody could anticipate and moreover define howlong is so called "temporarily" Based on our observation there are many refugee families who do not want to go back to East Timor due to various reasons such as have nothing left in East Timor, prefer to settle in West Timor and life with their families or relatives, etc
Besides that there are many refugees who are very afraid to go back to East Timor because their background in the past

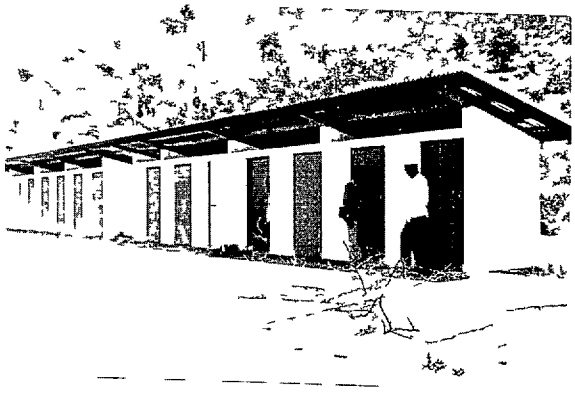
Therefore we decided to construct so called "adequate" sanitation facility which means simple but durable and environmentally sound (include the construction of proper septic tank and percolation ditch/well)
Suppose in the future no more refugees in respective location, at least that construction can still be utilised by indigenous population

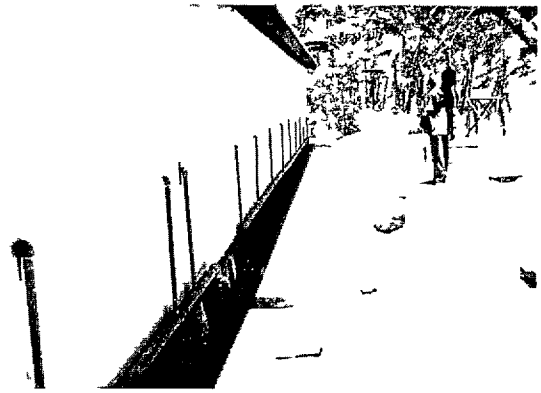



Starting the foundation for the sanitation unit (above left) Water taps within sanitation unit (above right)

Typical sanitation facility (above left and right)





Although invisible (underground) the proper treatment (septic tank and effluent percolation ditch) and drainage are very important otherwise the objective to rescue the refugees from serious health problem

**Sodis (Solar Disinfection)**

Trainings on utilisation of solar disinfection simple technology to produce potable water were conducted in every sites mentioned above
In this case the strategy is through the refugee group leader We identify that in one settlement there are several refugee groups who came from the same village And there were always a leader, informal leader or respected people in every group They were asked to contact all families to participate in this Sodis short training Usually women who attended this short training and after the training they were given 4 bottles to be used daily in order to produce potable water

Training materials such as poster and simple leaflet were sent from Yogyakarta (YDD contribution) which were developed by YDD in cooperation with Unicef Example of Sodis training leaflet and poster see Annex

Although Sodis technology is simple, but it really help the refugees Especially women because finding firewood to boil water is difficult and become their main burden On other hand other fuel such as kerosene is expensive and beyond their ability to pay With Sodis technology they don't have to do that again

However the fund from USAID is allocated for 2000 bottles only In the original proposal the idea is only to conduct training and provide demonstration If the refugees need more bottles they can buy on theirown or obtain from other local sources But in reality the location of refugees settlement is far from the city (where usually used plastic bottles are available) and on top of that they have no money to buy it

Understanding that problem, YDD approached the Aqua Golden Mississippi (producer of bottled water) in Jakarta They agree to donate 25,000 bottles and that had been shipped to Kupang in November 1999
At the writing of this report the distribution of that donated bottles from Aqua company is still going on


Distribution of Sodis bottles after the short training mainly to the women who are usually in charge to produce potable water for the families


Practicing on how to produce potable water for the families using Sodis technology simple cheap and release the women from their daily burden

## B 4 Handed Over and Post Construction O&M

As described above there were various extraordinary problems and difficulties in constructing water and sanitation facilities for the refugees
But more serious difficulty was the post construction operation and maintenance especially in determining actors responsible for that job
Moreover the water facilities described above involve pumping and power generator which need to be operated properly in order to make it functioning as it should

The core of the problems in any activity dealing with refugee was the fact that one have to work and deal with frustrated, emotional and desperate target groups Consequently all conventional community arrangement based on social cohesiveness such as formation of community group for operation & maintenance, organizing service fee, etc cannot be introduced
Therefore, in this context, local government and locally based organisation (such as church organisation) are the most appropriate parties to manage the operation and maintenance

In December 3rd 1999, USAID provide a mandate to YDD to conduct this hand over process This hand over process was conducted in mid of December 1999

In general all the operation and maintenance of those facilities are handed over to the local Government of Kabupaten Belu

Local government then distribute the O&M job to relevant "dinas", as follow

| No | Location | Dinas under Local District Government responsible |
|---|---|---|
| 1 | Terminal Lolowa | DLLAJR (because the location is in terminal area which is under the jurisdiction of respective dinas) |
| 2 | Haliwen | Local Govt Water Enterprise/PDAM (because PDAM is responsible to serve water to refugees in this site) |
| 3 | Desa Tenukiik | Local Govt Water Enterprises/PDAM with support from local military (because this location is close to the military camp) |
| 4 | Desa Raihenek | Authority of Kobalima Sub District in cooperation with local church |

## C Budget

The financial report of East Timor Refugees Support Program (Grant Agreement No 497-G-00-99-00035-00) is as follows (dated November 15th 1999)

| Budget Line Item | Approved Budget | Total Expenditure to Date |
|---|---|---|
| Personnel | 46,800,000 | 46,800,000 |
| Project Activity Costs | 960,700,000 | 963 600 000 |
| Other Direct Costs | 65,000,000 | 62 300 000 |
| Total | 1,072,500,000 | 1 072 700 000 |

# Annex

## SODIS Training Materials

# S DIS

# IDE DASAR SODIS

**SODIS adalah suatu teknologi sederhana yang memanfaatkan energi matahari untuk membunuh mikroorganisme patogen dalam air**

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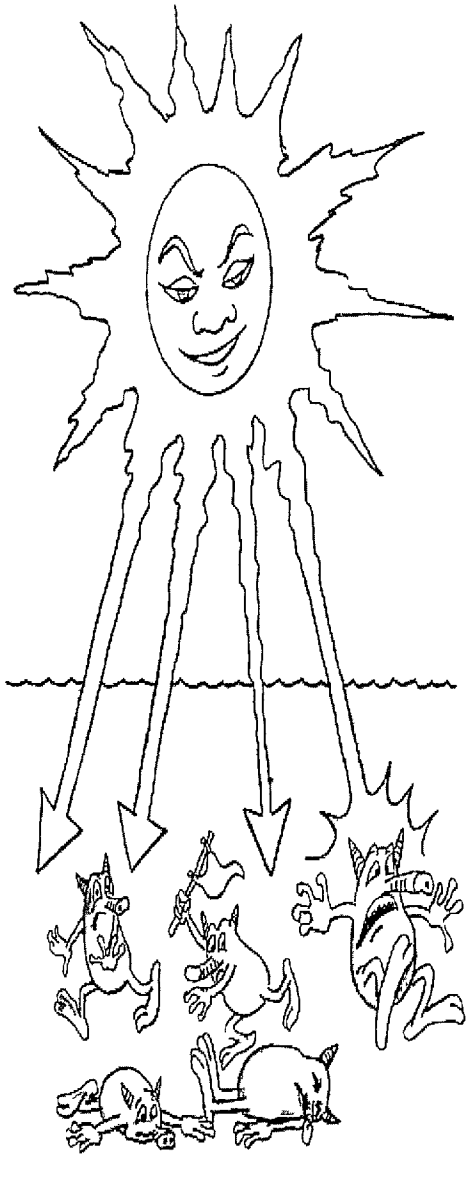
Yayasan Dian Desa
Yogyakarta, Indonesia

# APA ITU SODIS?

**SODIS adalah suatu metoda pengolahan air yang membuat air steril, untuk keperluan konsumsi rumah tangga**

**SODIS memanfaatkan sinergi sinar UV-A dan panas sinar matahari untuk membunuh mikroorganisme patogen di dalam air**

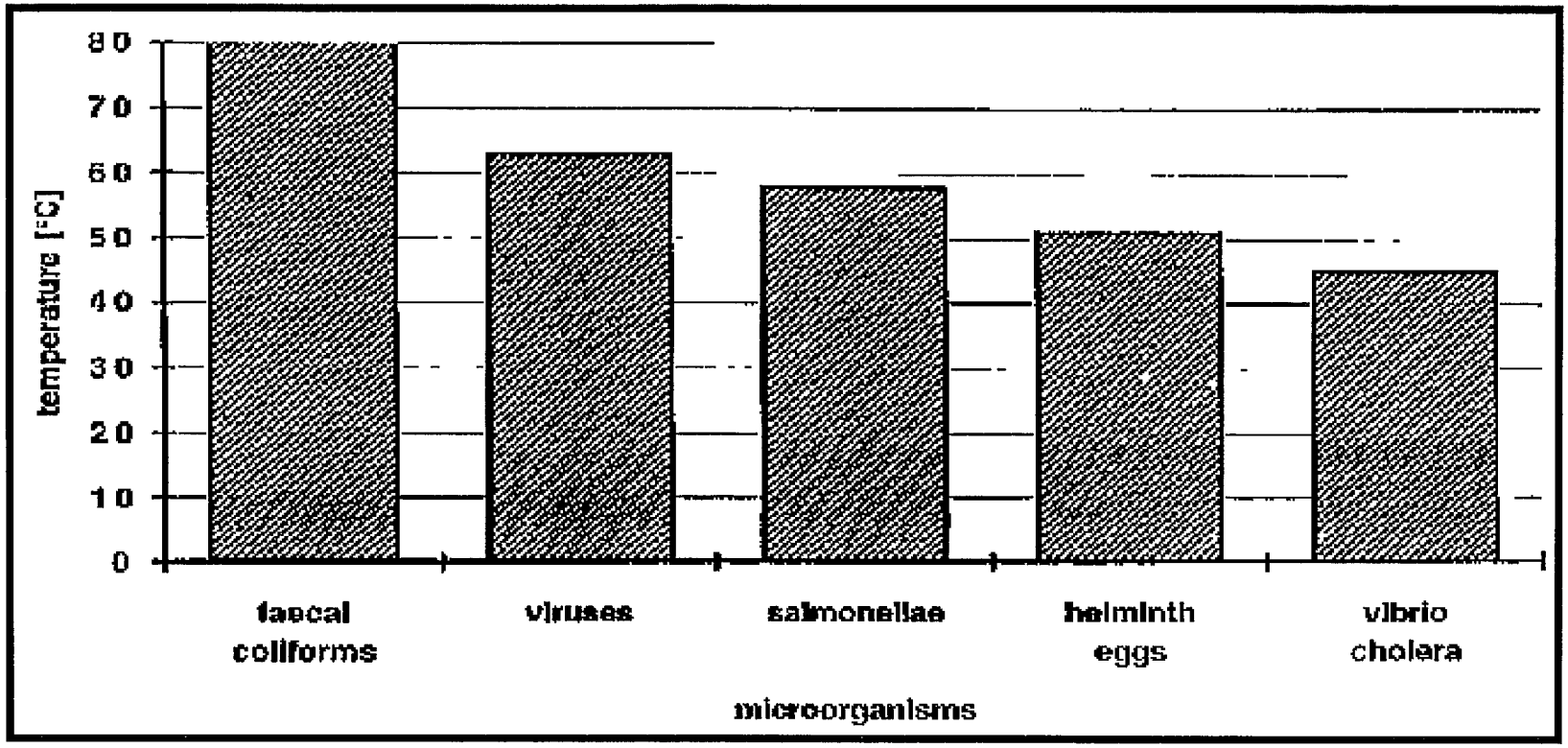




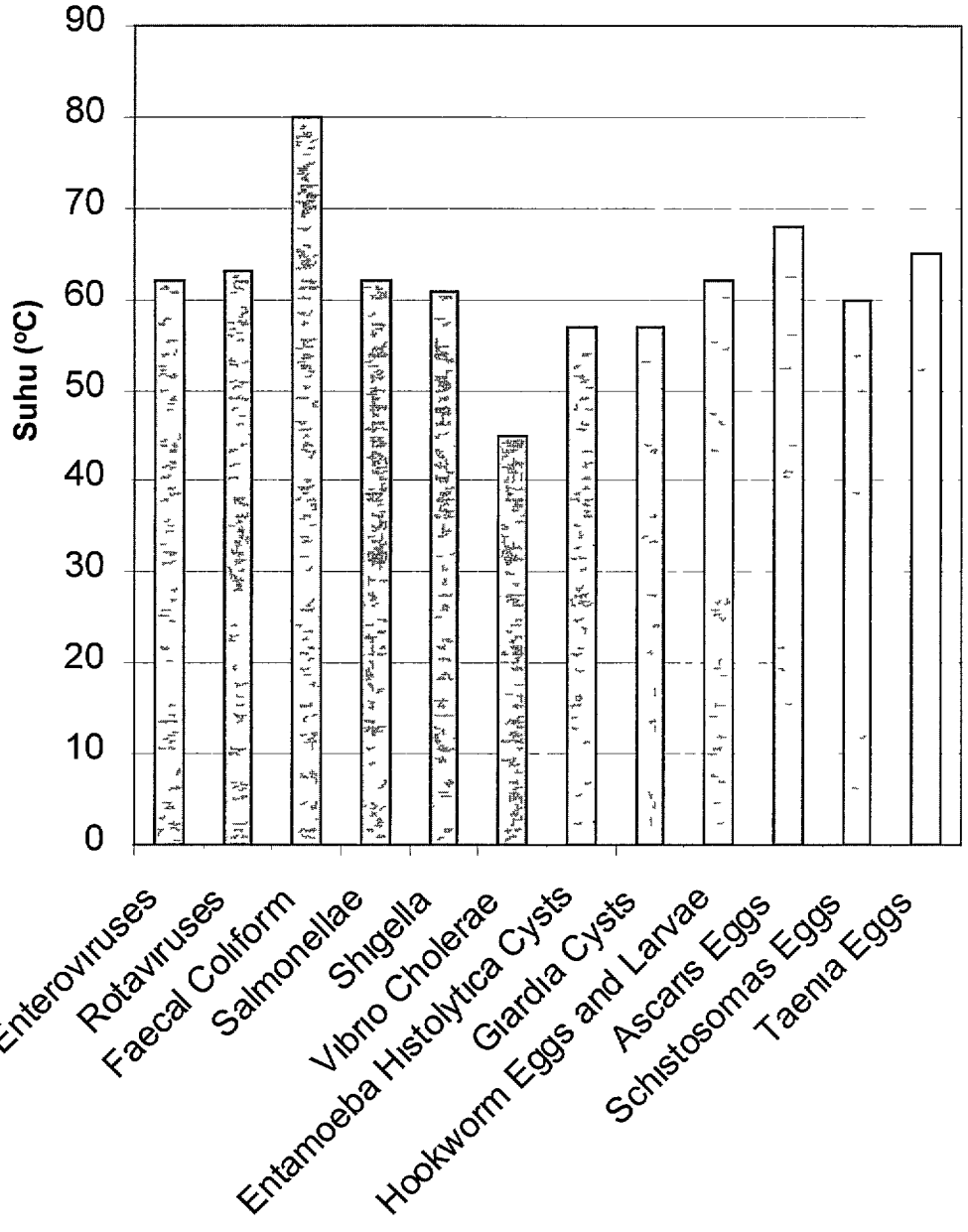
Yayasan Dian Desa
Yogyakarta, Indonesia

17

# DAYA TAHAN MIKROORGANISME TERHADAP SUHU



# Thermoresistensi Bakteri

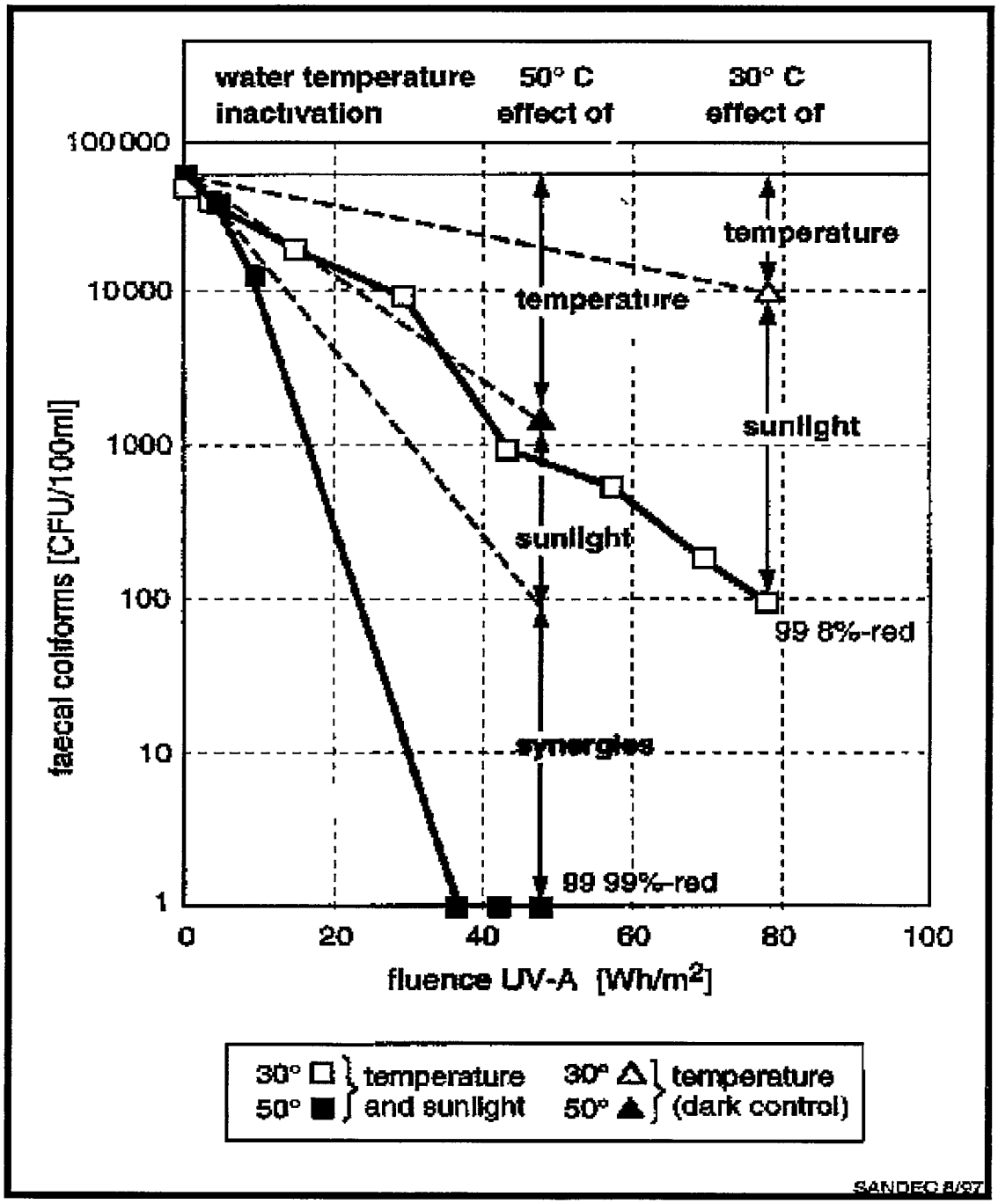


# Hasil SODIS pada kondisi yang berbeda

**Bagaimana bila air dipanaskan di atas 50°C dan di bawah 90°C tetapi tidak terkena sinar matahari**

**Bagaimana bila air dipanaskan dan terkena sinar matahari, tetapi tidak pernah mencapai suhu 50°C**

**Bagaimana bila air dipanaskan sampai suhu 50°C atau lebih dan terkena sinar matahari**


water temperature inactivation
50° C effect of
30° C effect of
100000
10000
1000
100
10
1
faecal coliforms [CFU/100ml]
temperature
temperature
sunlight
sunlight
99.8%-red
synergies
99.99%-red
0
20
40
60
80
100
fluence UV-A [Wh/m²]
30° □ } temperature
50° ■ } and sunlight
30° △ } temperature
50° ▲ } (dark control)
SANDEC 8/97

# Hasil percobaan di laboratorium menunjukkan bahwa sinergi yang terjadi dari gabungan radiasi sinar ultra-violet dan panas merupakan kunci keberhasilan pemusnahan bakteri *E. coli* dalam air.

Dua macam test dengan bakteri E coli dilakukan dengan mengontrol temperatur air pada suhu tertentu yaitu 30° C dan 50° C Salah satu sample hanya diberi panas saja (sebagai kontrol gelap), sedangkan yang satu lagi di paparkan pada sinar matahari (sehingga terkena UV dan panas)

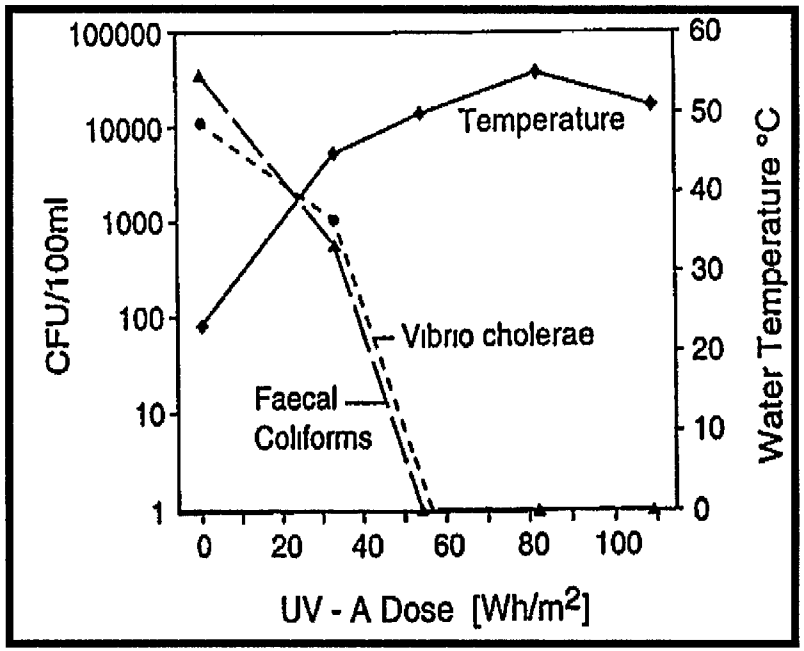
Hasil test menunjukkan bahwa pada tabung yang terkena sinar matahari, pada suhu 20 - 40° C pengurangan jumlah bakteri *E coli* tidak terlalu tinggi, bahkan dapat dikatakan tidak terjadi pengurangan Tetapi pada saat suhu air naik sampai mencapai 50° C, terjadi pengurangan jumlah bakteri yang cukup drastis hingga mencapai jumlah bakteri *E coli* 0 Tetapi ternyata proses ini tidak terjadi pada tabung kontrol gelap

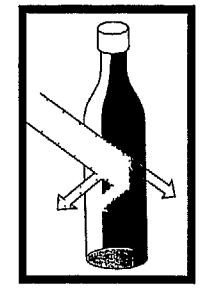
Jadi sebagaimana dapat dilihat pada grafik, pemusnahan bakteri *E coli* pada suhu 50° C disebabkan oleh

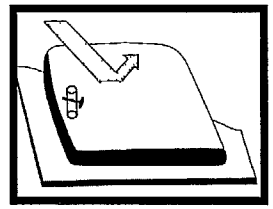
- Efek panas
- Sinar matahari, yang mengandung sinar UV
- Sinergi yang terjadi dari gabungan keduanya

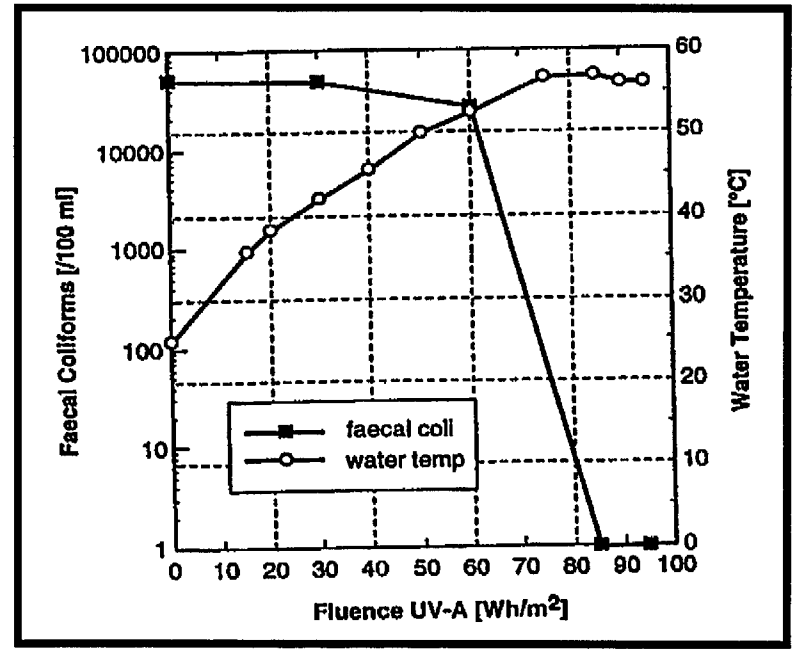
# PERBEDAAN HASIL

## AIR YANG DI SODIS DENGAN BOTOL DAN KANTONG PLASTIK



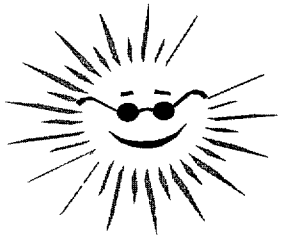




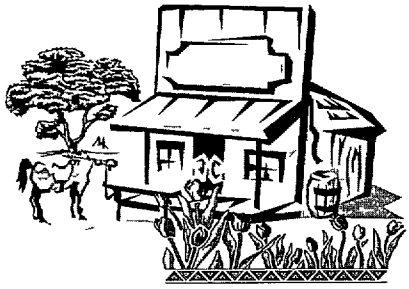

SODIS

Yayasan Dian Desa
Yogyakarta, Indonesia

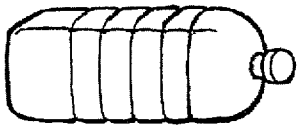
# Apa saja yang diperlukan untuk SODIS



**Sinar Matahari**



**Tempat yang terbuka**



**Botol plastik atau kaca transparan**


**Cat hitam dan kuas**



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Yogyakarta, Indonesia

# Hal yang perlu diperhatikan untuk mencapai hasil maksimal dari SODIS

Botol kaca/plastik transparan yang dicat setengah hitam

Matahari berlimpah : 4 - 5 jam

Mendung/berawan : 6 - 7 jam

**Air harus jernih atau kekeruhan dibawah 30 NTU**

**Temperatur air harus mencapai 50 derajat Celcius**



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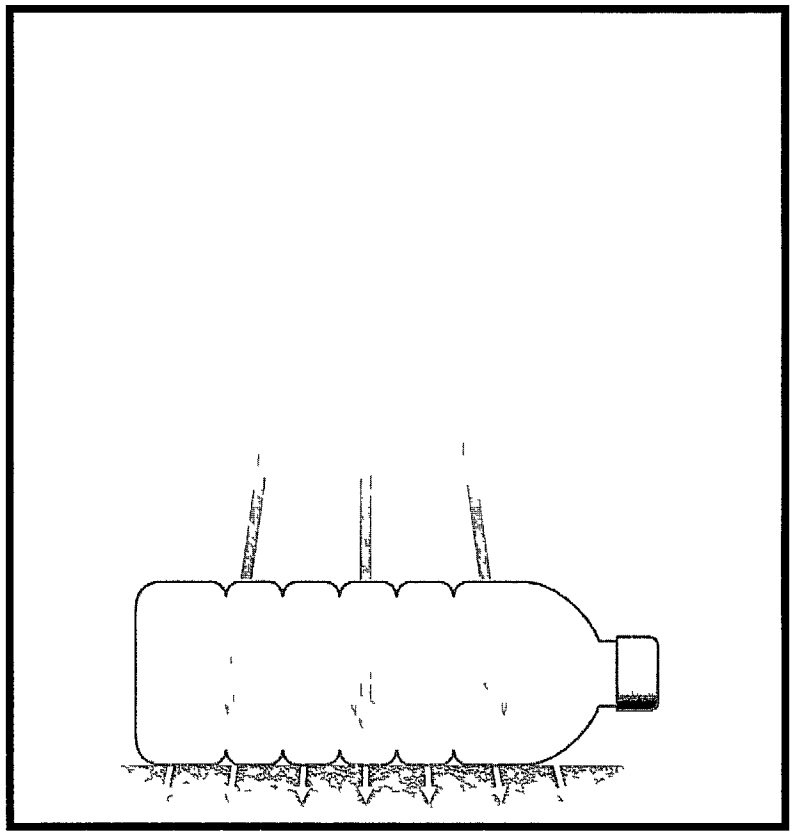
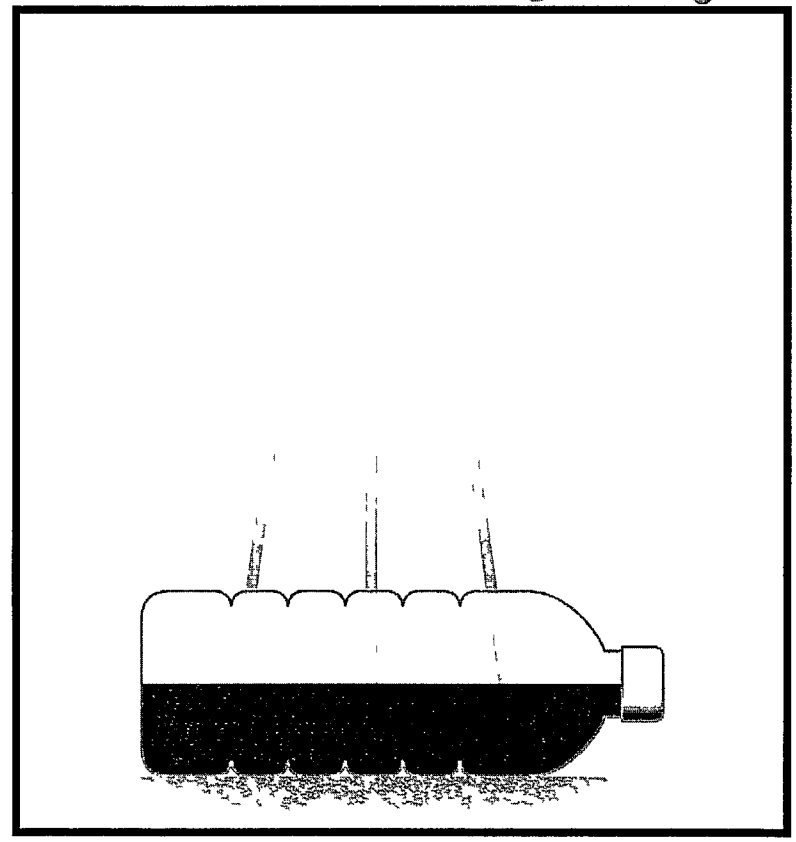
Yogyakarta, Indonesia

# Mengapa botol SODIS perlu di cat hitam setengah bagian?

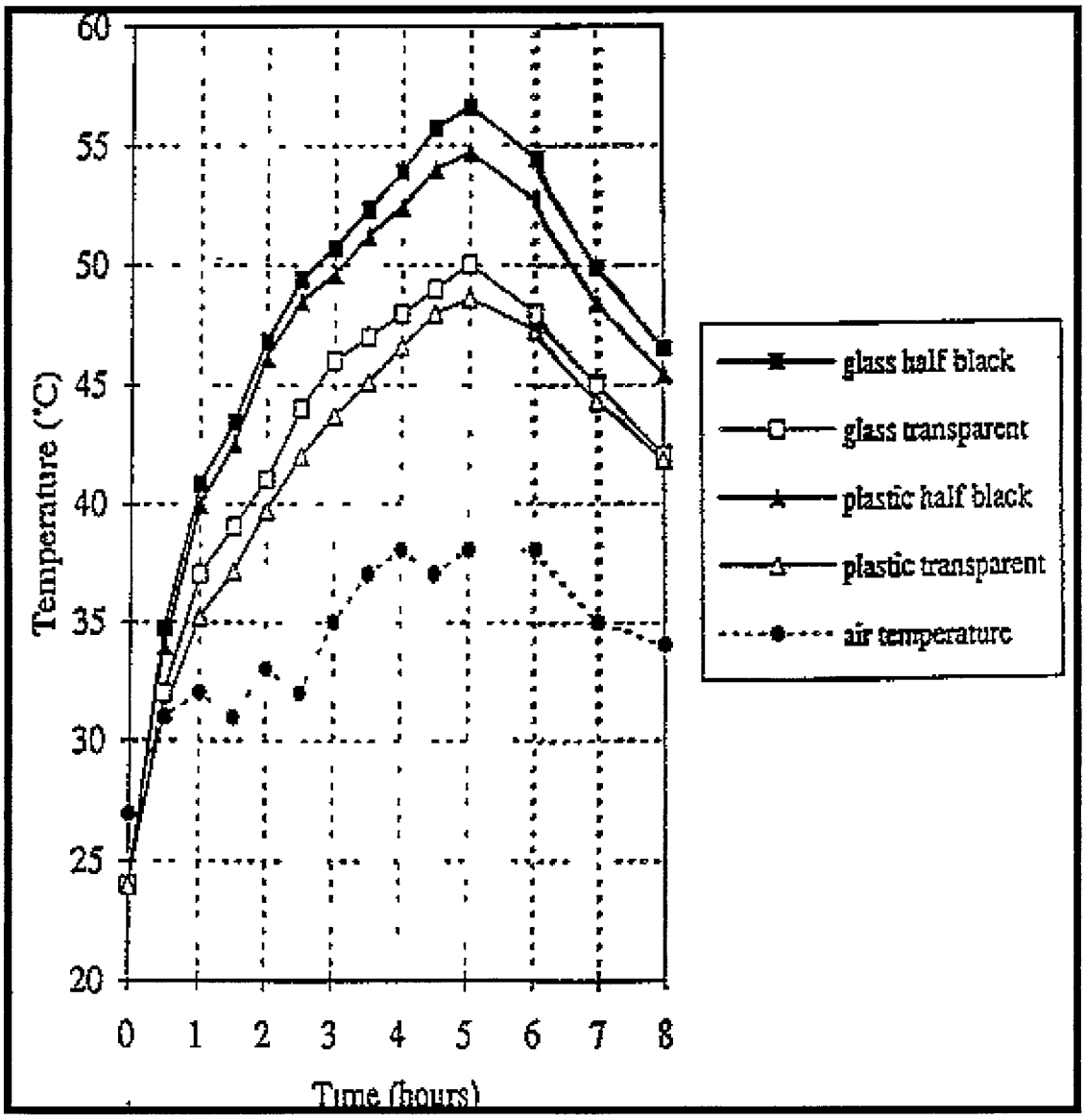




**Cat hitam berfungsi untuk menyerap panas, sehingga suhu yang dibutuhkan lebih cepat tercapai**

# UJI PEMANASAN AIR KEDUA

# HARI CERAH, INKLINASI 45°C

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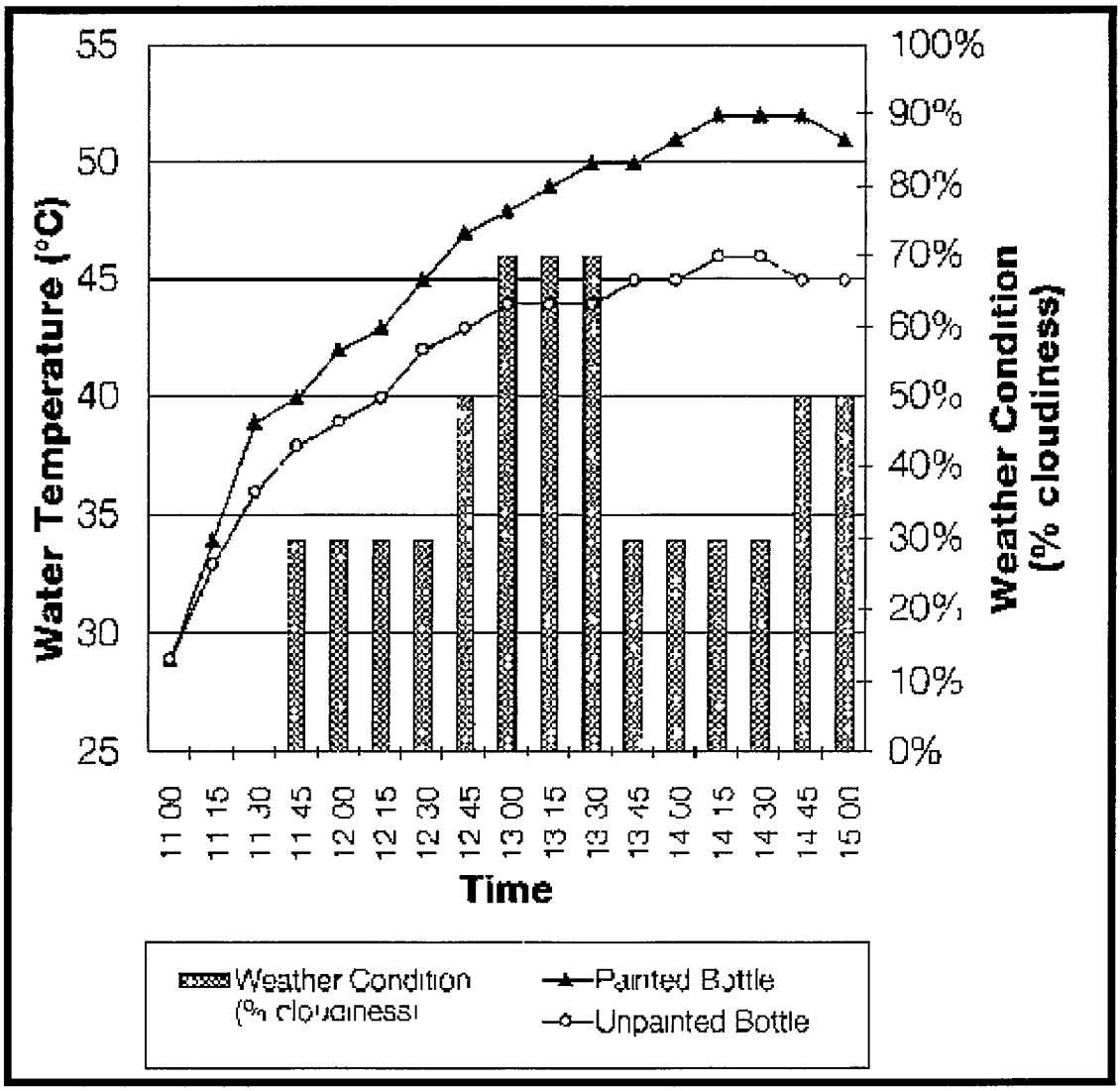
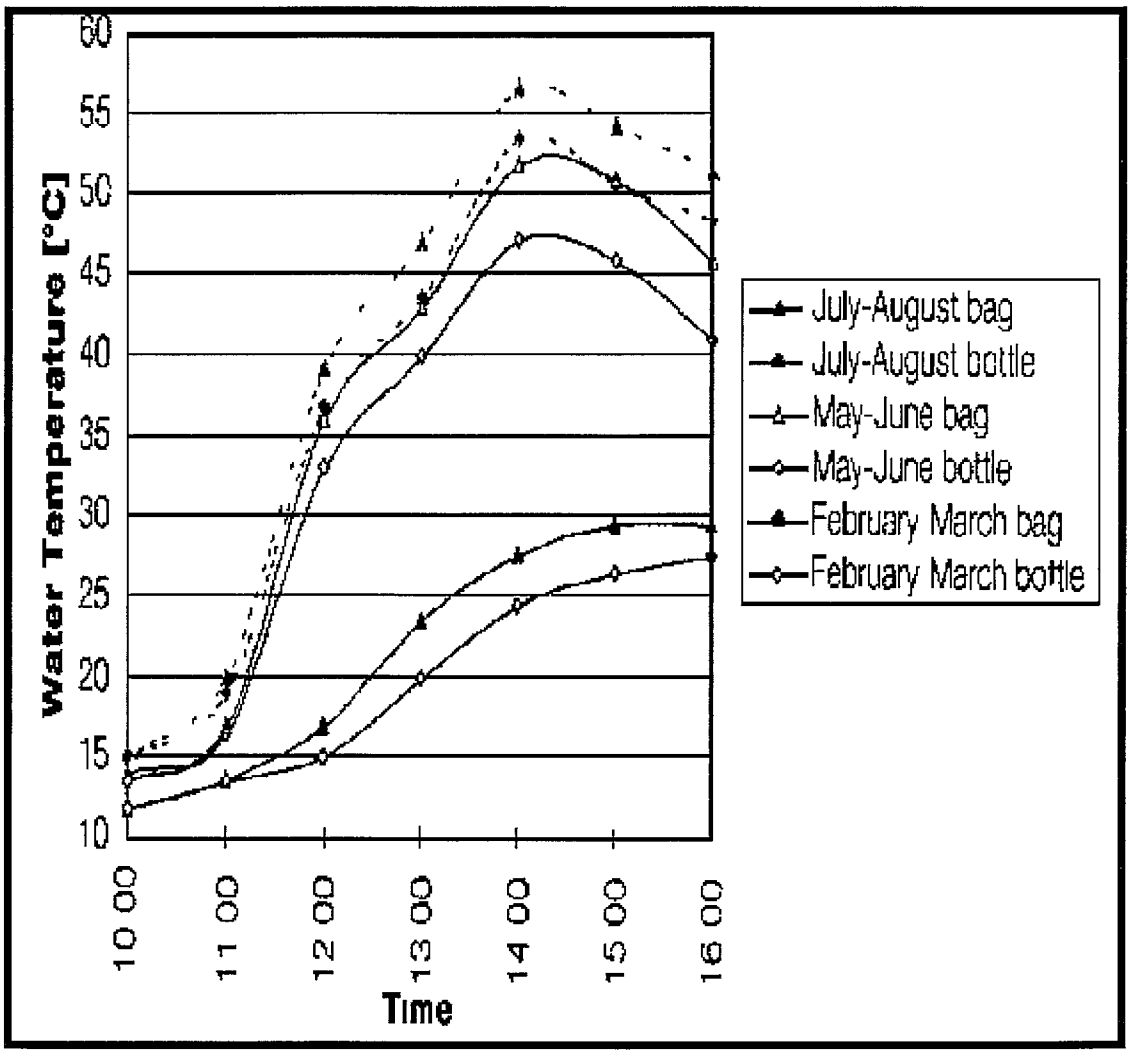
- **TEMPERATUR AIR PADA BOTOL SODIS YANG DICAT HITAM SETENGAH BAGIAN DAN YANG TIDAK DICAT HITAM, KEDUANYA DILETAKKAN PADA LEMBARAN SENG YANG DICAT HITAM.**
- **DIAGRAM BAR MENUNJUKKAN TUTUPAN AWAN**



# PERBANDINGAN TEMPERATUR AIR PADA BOTOL SODIS (DICAT SETENGAH HITAM) DAN KANTUNG SODIS




SODIS

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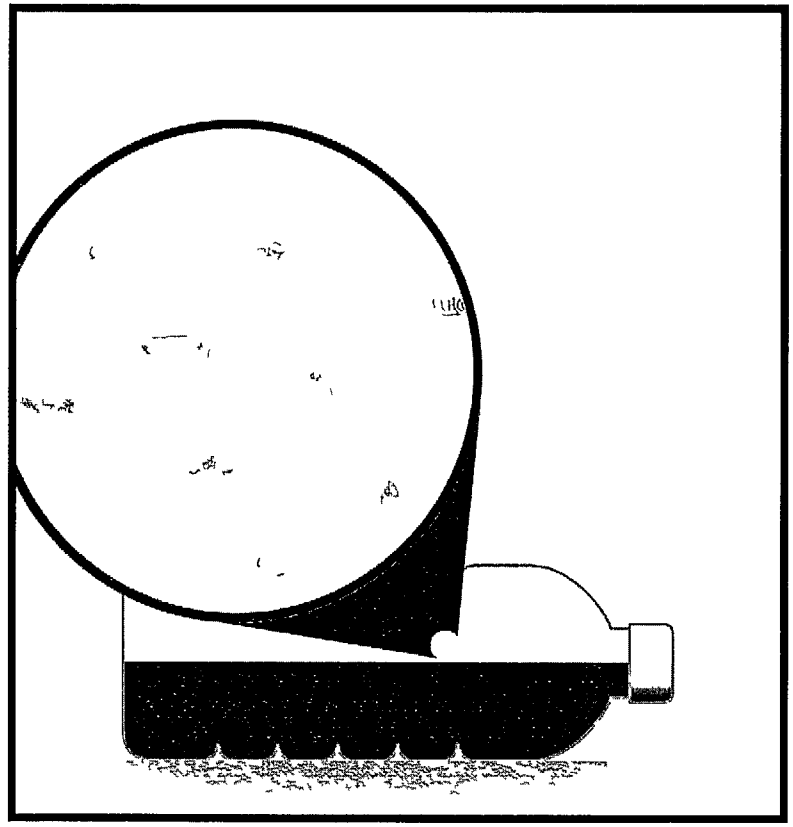
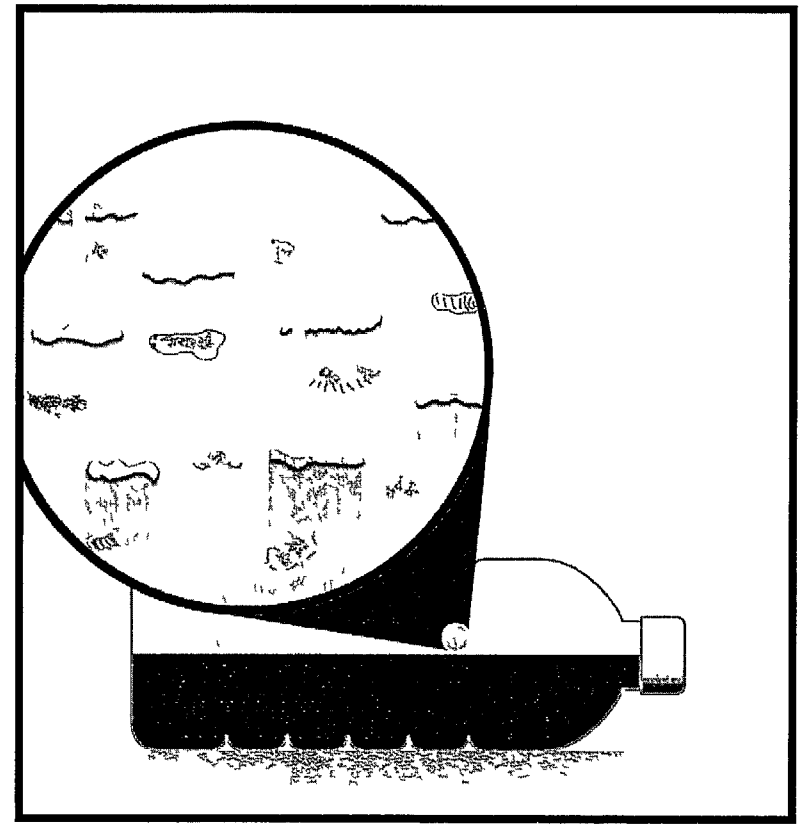
Yogyakarta, Indonesia

# Mengapa kita tidak dapat menggunakan air yang keruh untuk SODIS?



Sinergi dari panas dan sinar UV-A akan menembus ke seluruh air yang jernih dan membunuh seluruh mikroorganisme patogen yang ada

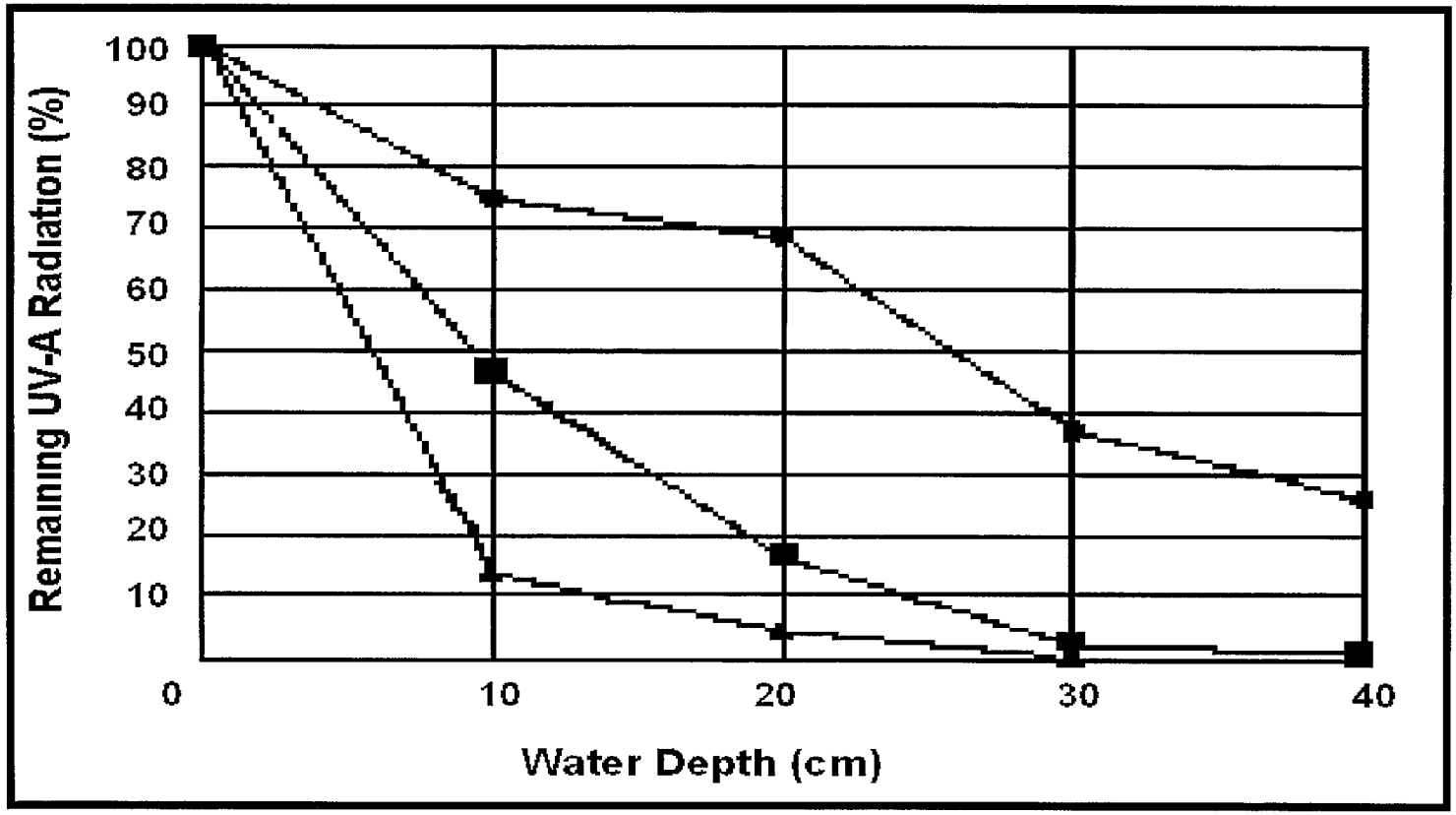


Jika air keruh, partikel dalam air akan menghalangi sinar UV-A dan panas untuk menembus air, sehingga mengurangi effisiensi pembunuhan mikroorganisme dalam air



Yayasan Dian Desa
Yogyakarta, Indonesia

# BERKURANGNYA RADIASI SINAR UV AKIBAT MENGGUNAKAN AIR KERUH




SODIS

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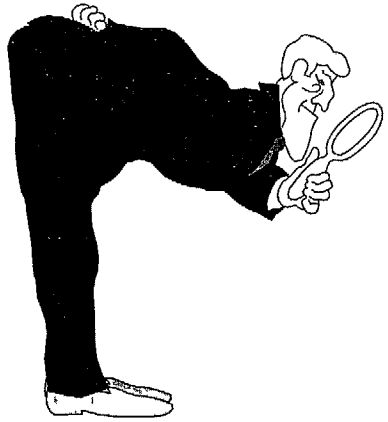
Yogyakarta, Indonesia



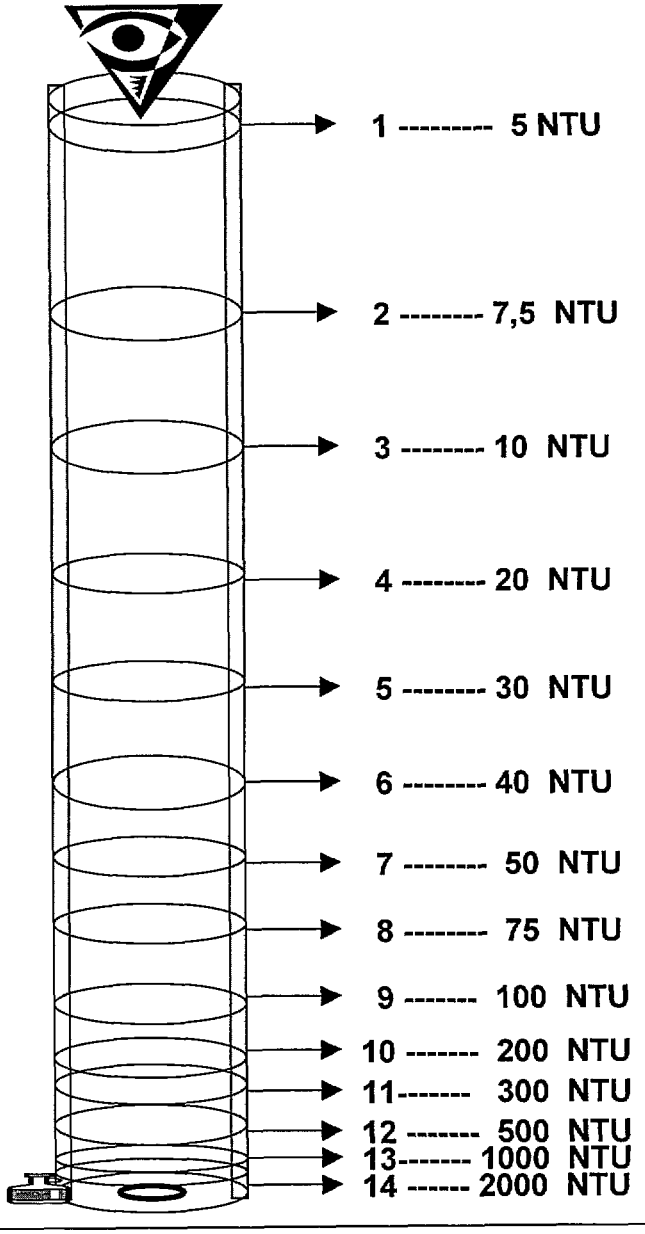
**Hasil percobaan menunjukkan bahwa intensitas sinar UV akan berkurang dengan cepat seiring dengan bertambahnya kedalaman air. Dampak berkurangnya intensitas sinar UV semakin bertambah besar dengan semakin keruhnya air.**

**Grafik menunjukkan berkurangnya intensitas radiasi sinar UV karena pengaruh kedalaman dan kekeruhan air, (●) air ledeng (NTU<1), (■) air yang telah disaring (26 NTU), (♦ ) air sungai (40 NTU). NTU = Nephelometric Turbidity Unit.**

**Semakin keruh dan semakin dalam air, semakin berkurang pula radiasi sinar UV.**

# Bagaimana mengukur kekeruhan air?

**Menggunakan tabung pengukur kekeruhan yang dikembangkan oleh Del Aqua, England**

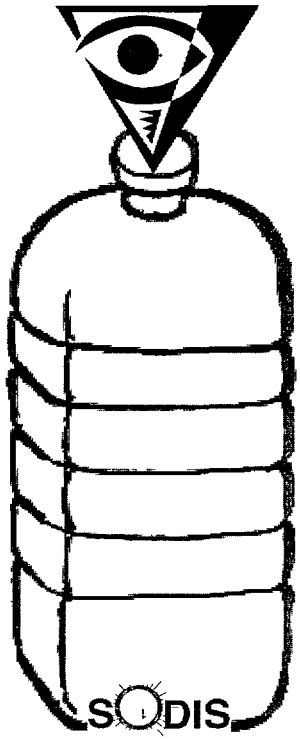



## Prosedur pengukuran

- Tuang air yang akan dianalisa ke dalam tabung pengukur, hindari percikan dan pembentukan gelembung udara Isi sampai tanda ke lima
- Amati tabung pengukur dengan posisi vertikal dan buka katupnya
- Segera tutup katup jika lingkaran hitam pada dasar tabung telah terlihat
- Lihat batas air, kemudian catat
- Buang semua air dari tabung pengukur dan bersihkan tabung tersebut

# Cara praktis untuk mengetahui kekeruhan air yang akan diSODIS

**Pengukuran ini harus dilakukan di tempat yang teduh, sehingga tidak terpengaruh sinar matahari**




**Ambil satu botol transparan ukuran 1 5 liter Isi dengan air yang akan di SODIS Letakkan logo SODIS di bawah botol tersebut, kemudian lihat melalui lubang botol**

**Jika anda dapat melihat logo tersebut melalui air, artinya kekeruhan air di bawah 30 NTU dan cukup baik untuk di SODIS**

**Jika anda tidak dapat membaca logo SODIS tersebut melaui air, artinya air tersebut memerlukan proses penyaringan atau penjernihan sebelum di SODIS**

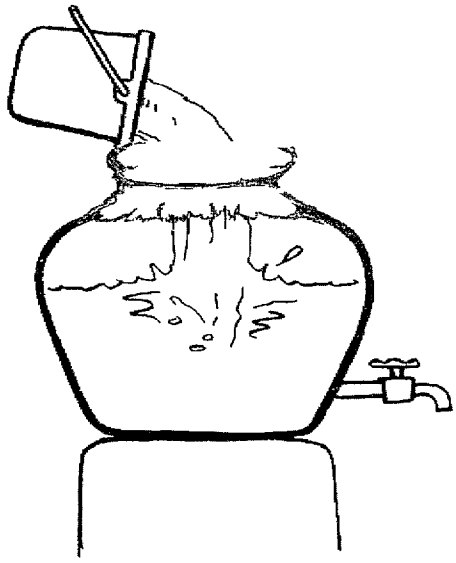


Yayasan Dian Desa
Yogyakarta, Indonesia

# Bila air keruh apa yang harus dilakukan?

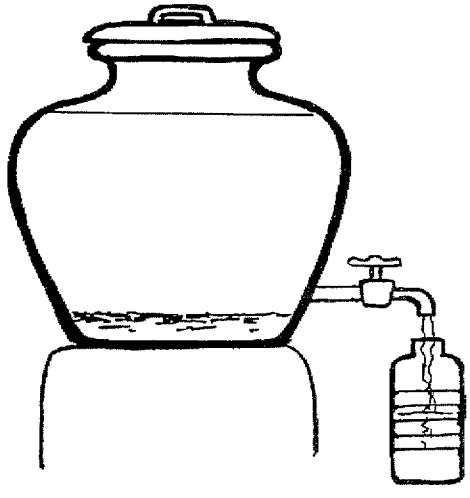
**Saring air dengan kain yang berpori halus**

**Diamkan selama dua jam**



**Ambil air yang sudah bersih tersebut hati-hati, jangan sampai merusak endapan yang telah terbentuk**

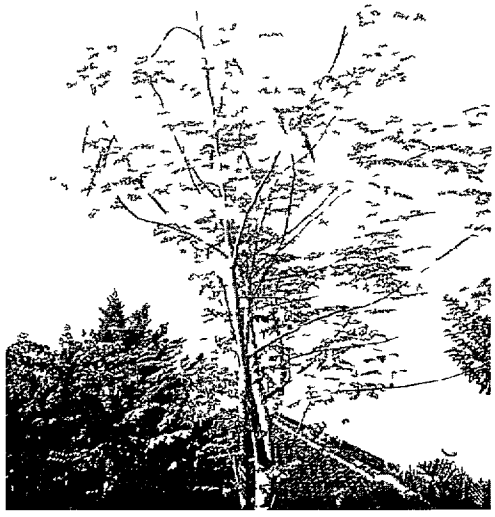
**Masukkan air ke botol SODIS untuk di SODIS**



# Jika filtrasi tidak cukup apa yang harus dilakukan?

## Gunakan Tawas

## Gunakan biji kelor (*Moringa oleifera*)



**Pohon Kelor (*Moringa oleifera*)**

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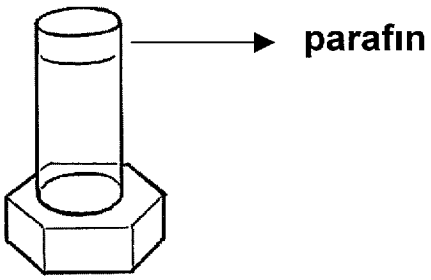
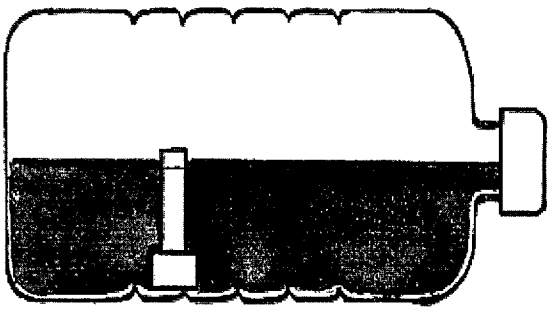
Yayasan Dian Desa
Yogyakarta, Indonesia

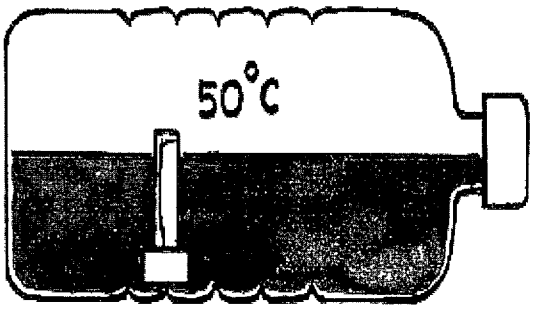
# Bagaimana mengetahui suhu air mencapai 50 derajat Celcius



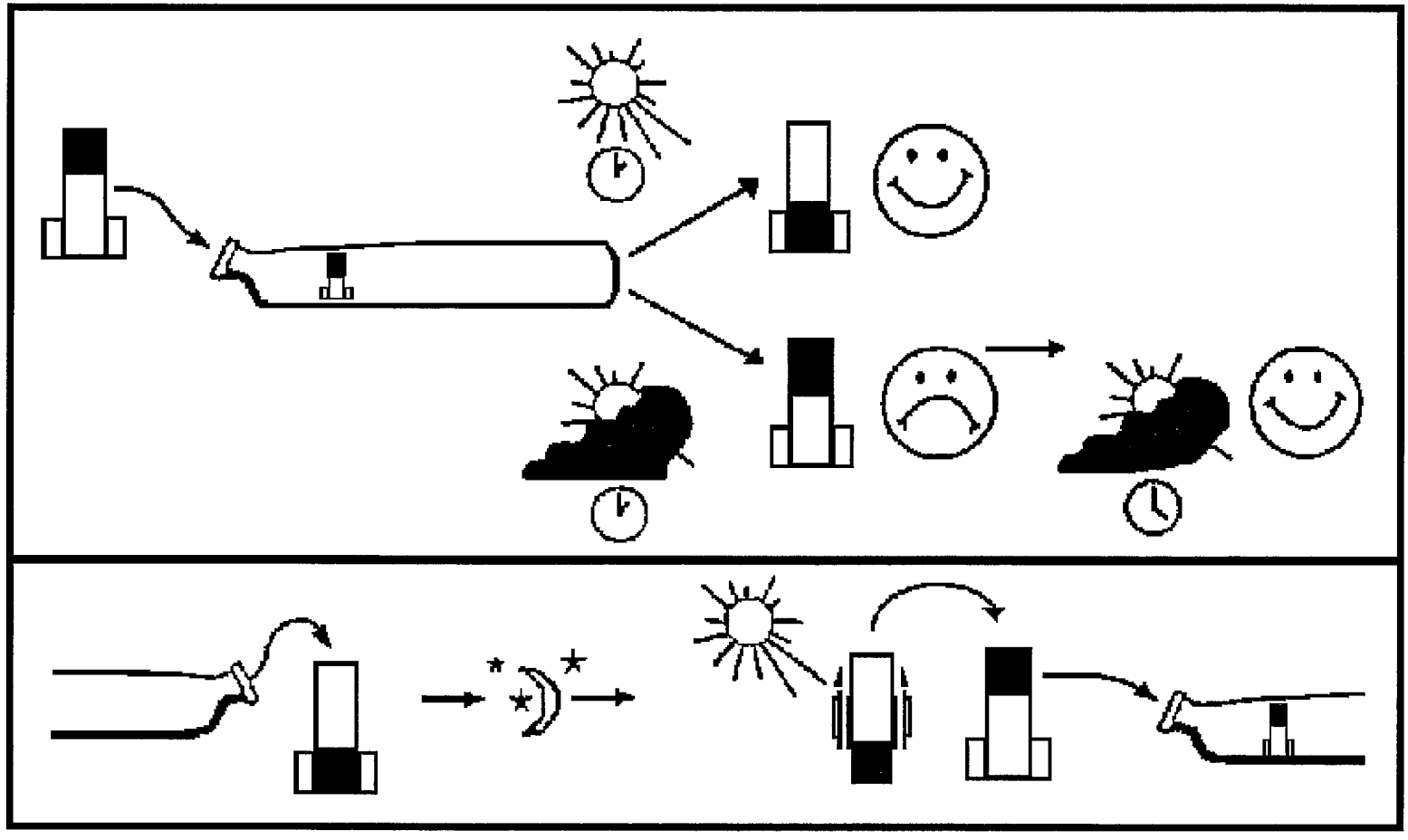

**Gunakan sensor suhu**



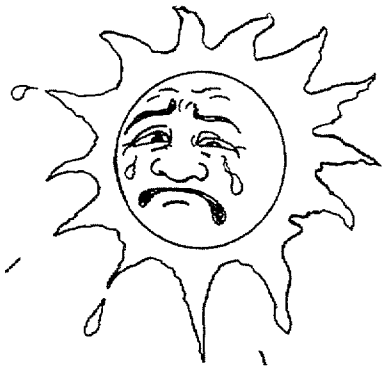
**Letakkan alat sensor suhu dalam botol dengan posisi tegak dan parafin di bagian atas**




**Pada saat parafin meleleh, suhu air tersebut mencapai 50°C.**

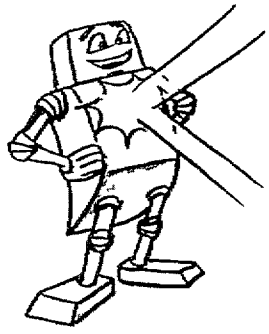


# PIKTOGRAM TEMPERATUR SENSOR

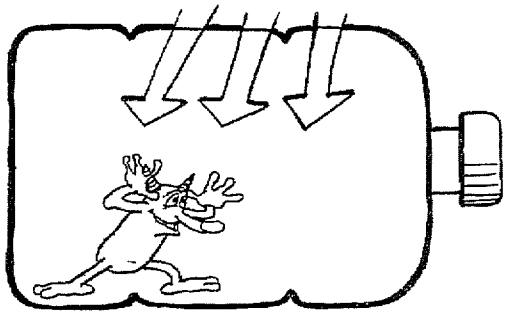


# Apa saja yang tidak dapat dilakukan SODIS

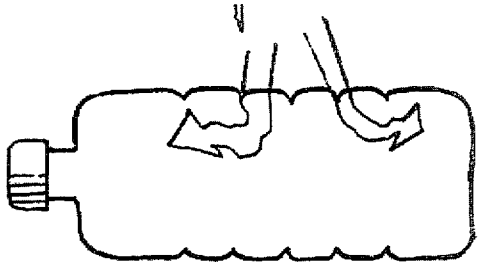
**Mengubah atau menghilangkan kandungan kimia dalam air** →



**Mengolah air dalam jumlah besar sekaligus** →

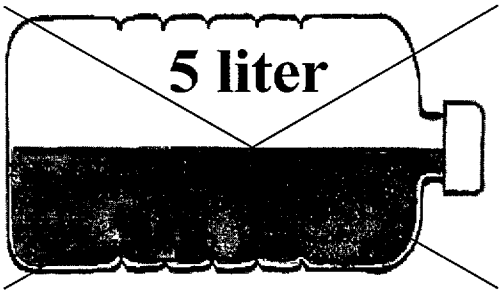


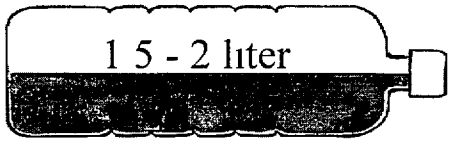
**Mengolah air yang kekeruhannya diatas 30 NTU** →

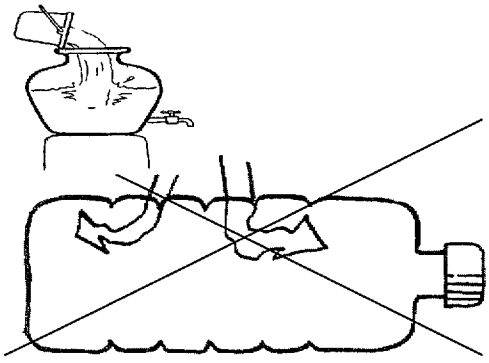


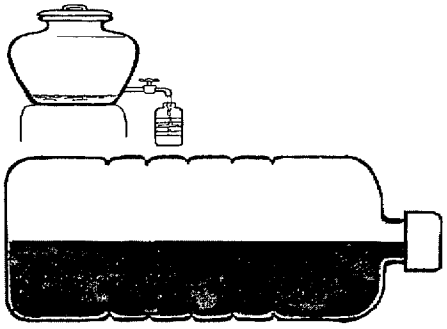
# Ouh No!

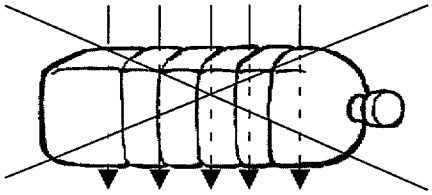
# Yes OK!

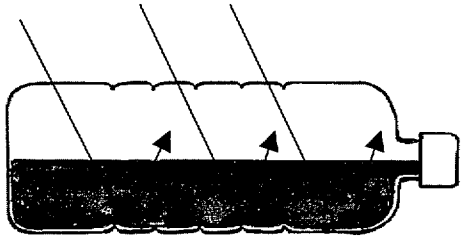


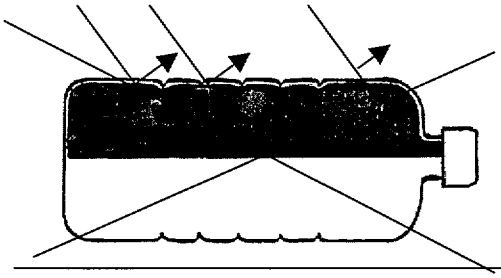



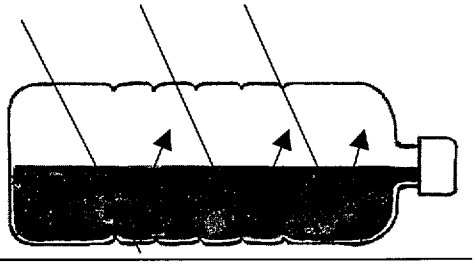













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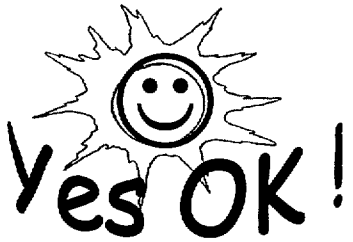
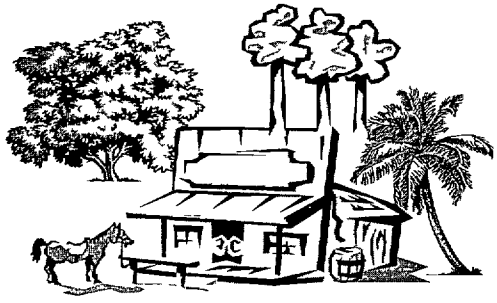


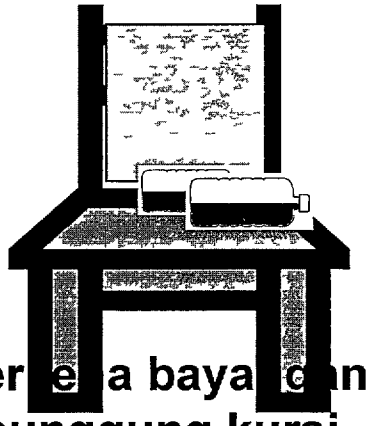

Terlalu berawan/
hujan

Cukup sinar
matahari

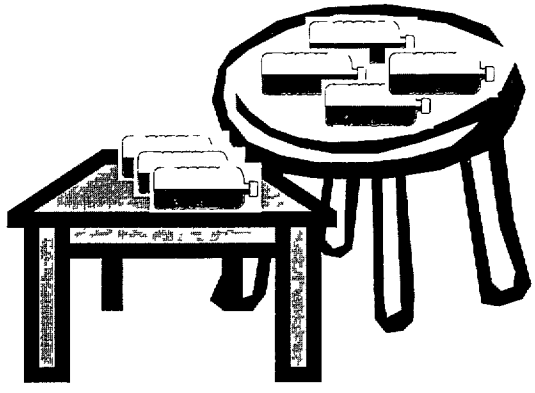
Terlalu teduh



Tempat terbuka

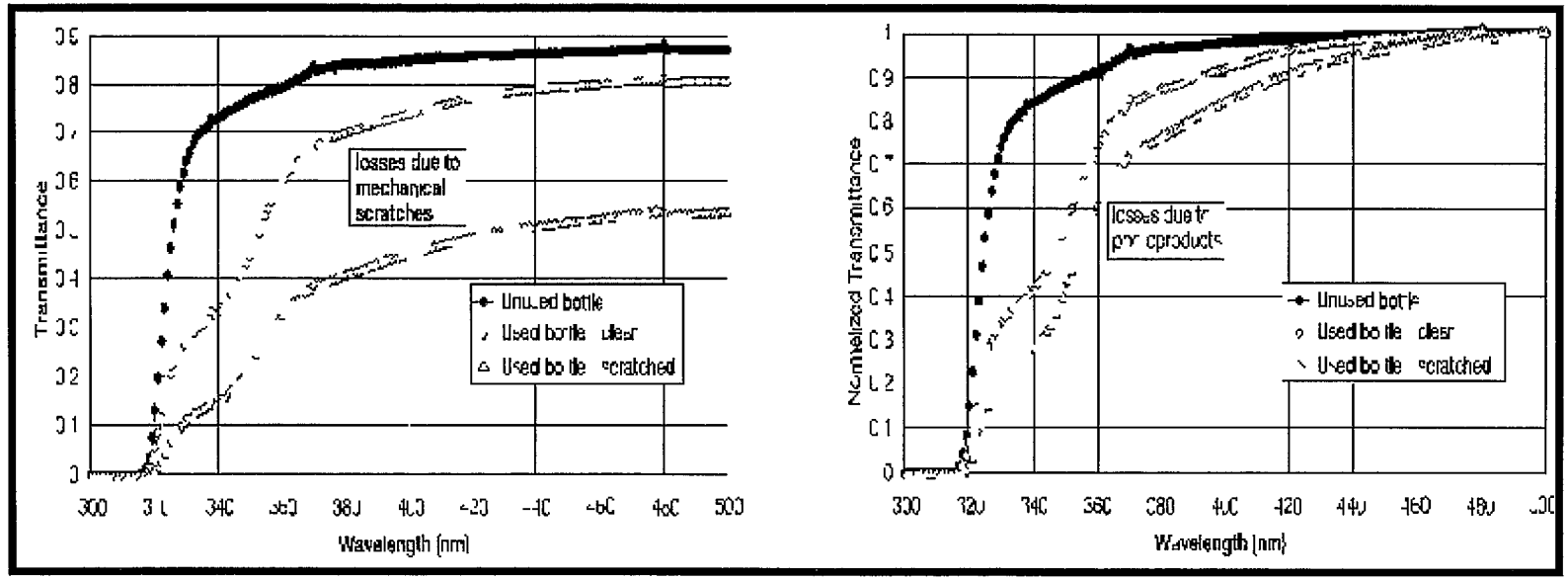


Terlalu banyak bayangan
punggung kursi



Tidak ada bayangan

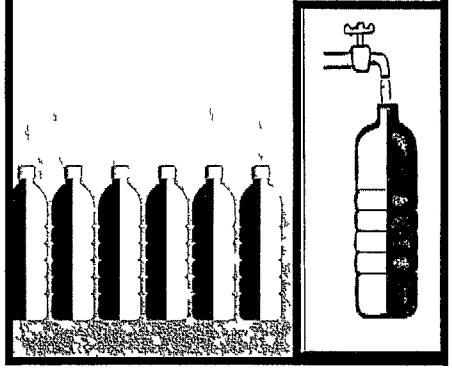
# HILANGNYA TRANSMISI UV AKIBAT MECHANICAL SCRATCHES (KIRI) DAN PHOTOPRODUCTS (KANAN)



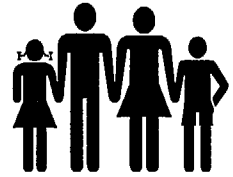
# Cara Melakukan SODIS

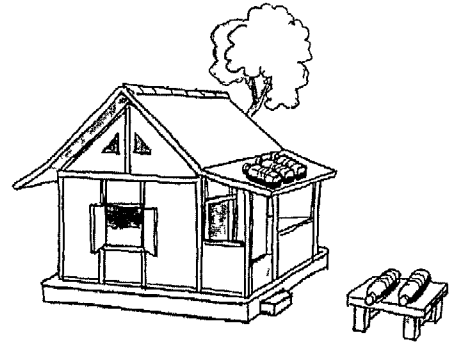
Siapkan sejumlah botol untuk mencukupi kebutuhan keluarga

Isi dengan air



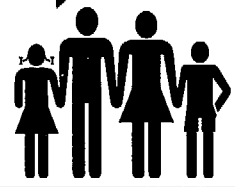
Keluarga kami ada 4 orang
Tiap hari kami butuh 8 liter air
1 botol = 1 5 l iter
Kami membutuhkan botol = 12
6 untuk pengolahan SODIS
6 untuk dikonsumsi

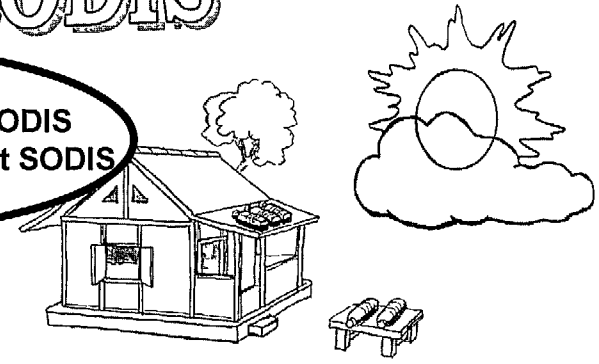




Jemur di bawah terik matahari selama 4-5 jam, bila matahari bersinar cerah

Sekarang kami minum air SODIS dan keluarga kami sehat berkat SODIS





Jemur di bawah terik matahari selama 6-7 jam bila agak mendung

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Yogyakarta, Indonesia

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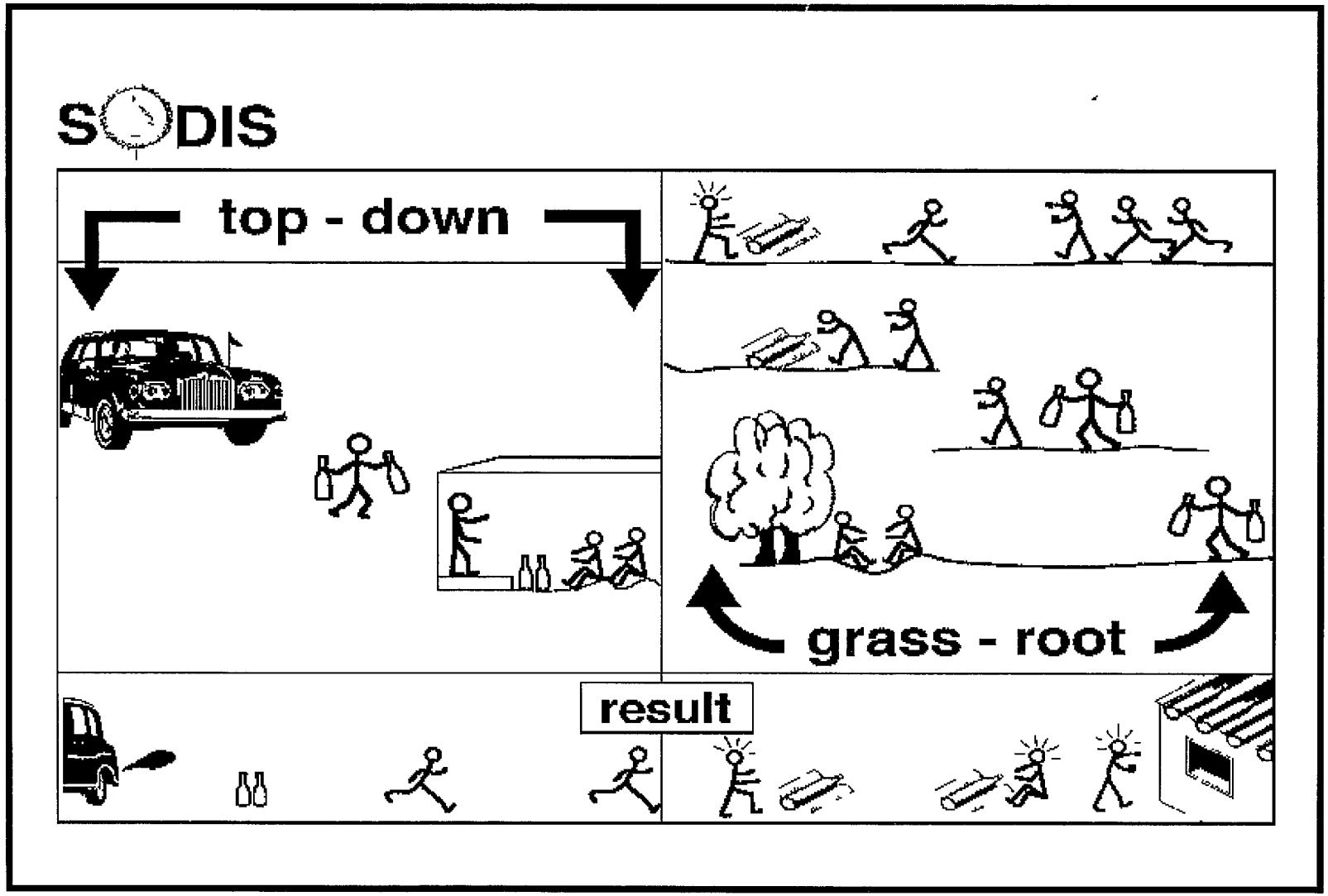
SODIS
top - down
grass - root
result