Practical Aquaculture 6

By

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The ***Penman Formula*** is based on data of atmospheric pressure, radiation, sunshine, humidity, air temperature and wind speed.

$$E0 = (0.015 + 0.00042T + 10^{-6}z)\,[0.8R_s - 40 + 2.5Fu(T - T_d)] \quad (\text{mm day}^{-1})$$

T is the daily mean temperature (i.e. the average of the extremes)

z is the elevation (m)

Rs is the solar irradiance of the pond's surface

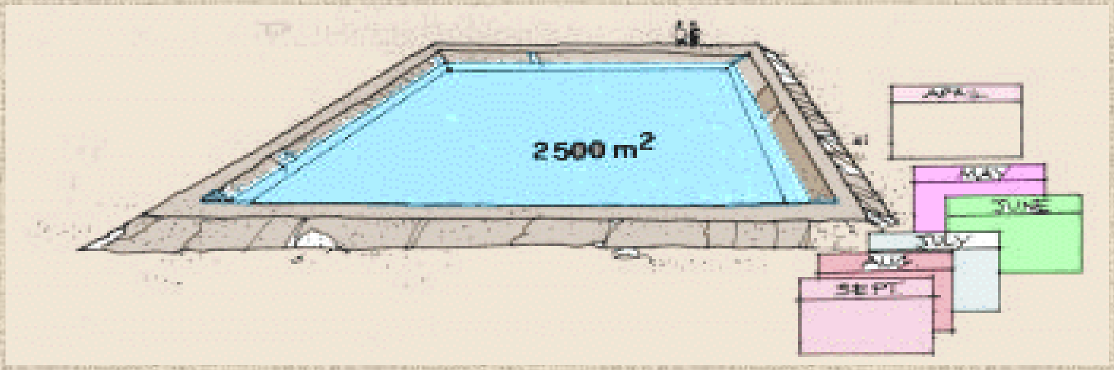
net **radiant energy exchange in the same units as the evaporation**

u is the wind speed at 2 m

F (constant) (we use 0.27)

Td is the dewpoint temperature

Td can be estimated from the daily extreme temperatures

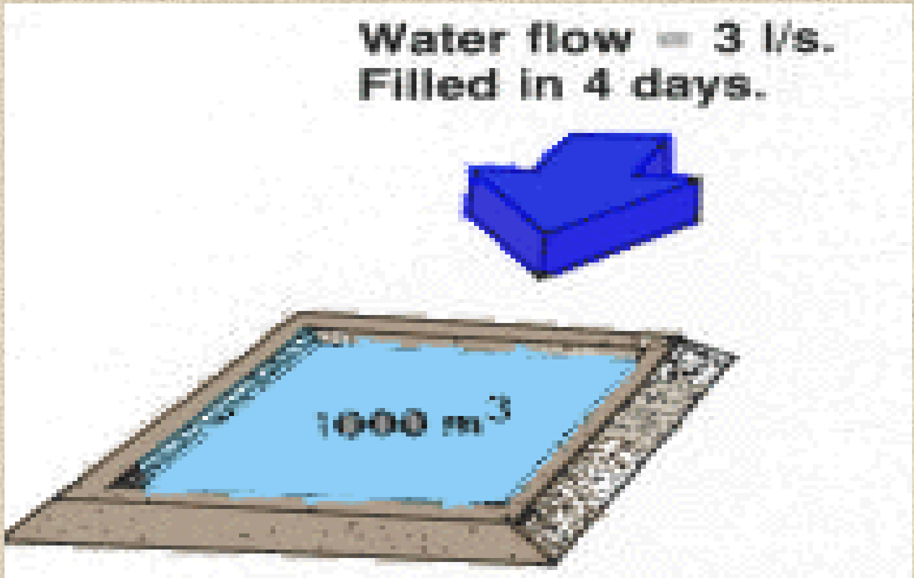


Pond size and water flow required

Before you begin to build a pond it will be helpful to compare the number of days needed to fill ponds of various sizes and the rate of water flow required. Table 1 will give you a quick idea of some of the combinations possible.

Days needed to fill ponds of various sizes and the rate of water flow required

Approximate filling time (days)	Pond volume (m^3)	Required water flow (l/ s)
8	400	0.5
	1000	1.5
	2500	3.5
	10000	14.0
4	400	1.0
	1000	3.0
	2500	7.0
	5000	14.0
	10000	28.0
2	400	2.0
	1000	6.0
	2500	14.0
	10000	56.0



Example

During the dry season, the water supply available decreases to 4 l /s for 2 months. You find that during this period the seepage losses for the kind of soil your pond is on are 7 mm/day . You also find that evaporation losses from the surface of the pond are 5 mm/day . The total seepage and evaporation losses for this period are then 7 mm/day + 5 mm/day = 12 mm/day, which, expressed in meters, is

12 ÷ 1 000 = 0.012 m/day.

So the water losses per hectare of pond area can be calculated in m^3 /day as follows:

0.012 m/day over 1 ha = 0.012 m x 10000 m^2 = 120 m^3/day/ha

Expressed in l/s/ha as equal to (120 x 1 000 l) ÷ 86 400 s or 1.4 l/s/ha of pond area.

The pond area (in ha) that can be maintained with a minimum water flow of 4 l/s can then be calculated as equal to:

4 l/s ÷ 1.4 l/s = 2.8 ha of fish ponds.

1 day = 86 400 s

SOIL PROPERTIES IMPORTANT FOR FRESHWATER FISH CULTURE

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Classification tests

If you are planning to build a small fish-farm, most of the classification tests required can be done by you in the field.
If you are planning to build a large fish-farm, more complex classification tests may be necessary and you will have to request them from a specialized laboratory. You should know which tests to ask for and you should be able to understand their results. For a more precise interpretation, you may have to consult a civil engineer and you must be able to interpret his technical conclusions. You will learn how later in this manual

Planning a small fish-farm

If your construction project is small in size, field tests may be sufficient to qualify the following soil properties:
Color, a good indication of drainage conditions;
Texture, the relative proportions of particles of various sizes;
Structure, the way in which the soil particles are assembled;
Consistency and plasticity, the strength with which the soil material is held together when dry, moist or wet;
Permeability, the rate at which water seeps down vertically.

Index properties of soils for freshwater fish culture

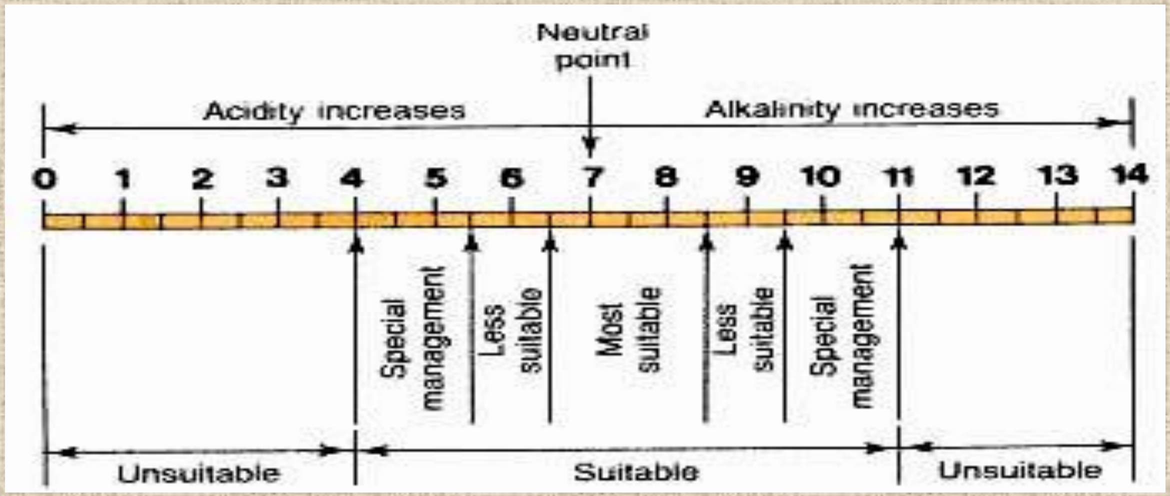
SOIL TYPE	Odour[2]	Colour — mottling	General texture	Particle-size analysis (L)	Shaking test[2]	Dry consistence	Moist consistence	Liquid limit — plasticity (L)	Plastic limit — plasticity (L)	Structure	Permeability — field	Coefficient permeability (L)	pH (L)
TESTS YOU CAN MAKE YOURSELF	●	●	●		●	●	●			●	●		
Sand, gravel		●		●									
Inorganic silt		●	●	●	●	●	●	●	●	●	●	●	●
Inorganic clay		●	●			●	●	●	●	●	●	●	●
Loess		●	●	●	●	●	●	●	●	●	●	●	●
Organic silt	●	●	●	●	●	●	●	●	●	●	●	●	●
Organic clay	●	●	●			●	●	●	●	●	●	●	●
Peat	●	●	●										
Composite soil[1]	●	●	●	●	●	●	●	●	●	●	●	●	●

(L) = Laboratory test

CHEMICAL PROPERTIES OF SOIL

The chemical qualities of soils change with time

The weathering of the parent material by water determines, to a large extent, the chemical composition of the soil which has ultimately been produced. Some chemicals are **leached*** into the lower soil layers where they accumulate. Other chemicals, more insoluble, are left in the upper layers of the soil. The most rapid removed chemicals are chlorides and sulphates, followed by calcium, sodium, magnesium and potassium.
The silicates and oxides of iron and aluminium decompose very slowly and are rarely **leached***. When some of these products come into contact with the air in the soil, chemical reactions occur, such as **oxidation** in particular, which results in the formation of chemicals either more soluble or more fragile than the original ones. This results in an acceleration of the weathering processes, increased **leaching*** of chemicals, and further changes in the soil chemical composition.



Soil suitability for the building of earthen ponds

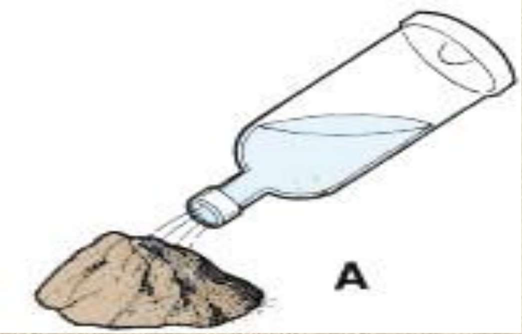
the coefficient of permeability of soils to be used for pond bottoms should preferably be smaller than

K = 5 x 10-6 m/s.

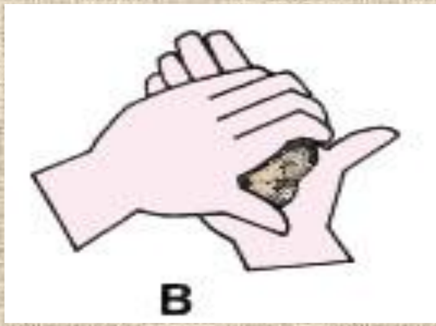
A simple test for soils to be used in building embankments

It is very important to know the **ability of a soil to resist water saturation*** when you are selecting soil material for embankment construction. Here is a very simple test that you can perform to determine this soil quality

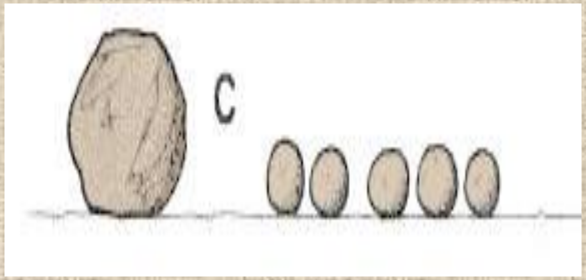
Take a sample of the soil and wet it well



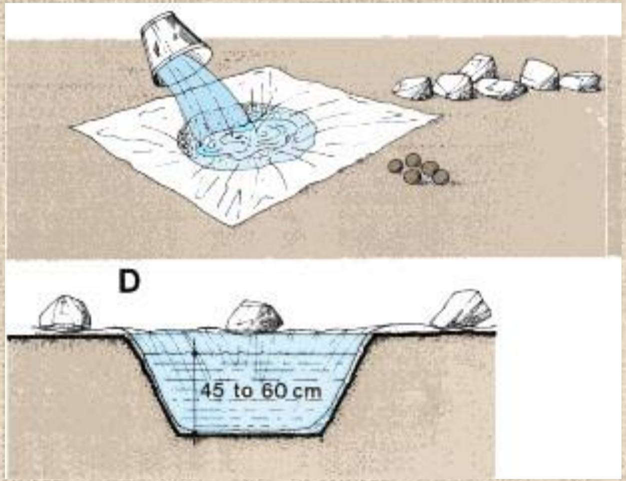
Knead it with your hands until it becomes a stiff plastic mass



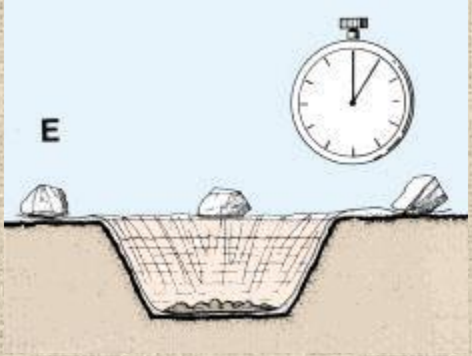
Make several balls, each about 10 cm in diameter



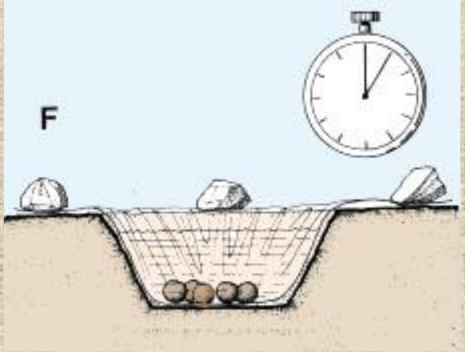
Put the balls in **still water** about 45 to 60 cm deep. You can use a hole dug in the ground and lined with a plastic sheet or a large container such as a 200 l metal drum



Look at the balls of soil every few hours at first, and later several times a day



If the balls do not fall apart but remain intact for at least 24 hours (F), the soil is **good** for embankment construction



Fish feeding

Types of Natural Food

UNICELLULAR ALGAE

FILAMENTOUS ALGAE

LAB-LAB

benthic (bottom dwelling) blue-green algae and diatoms, together with other plants and animals

LUMUT

filamentous green algae, together with other algae and animals.

BACTERIA AND FUNGI

ZOOPLANKTON

MUD EATERS

insect larvae such as chironomids and various worms, which ingest mud and detritus and derive nutriment from the bacteria and fungi living on it

OTHER INSECT LARVAE