Abstract


The moving of the water and the moving of mineral substances through the soil is a problem which has to be determined as soon as possible, because of the increase of mineral substances in the soil, pollution of the soil and the increase of underground water, which will create a significant problem in the future of the civilization. With this programme, we can define the contents of mineral substances in every “cm” of the depth of the soil; we can trace the pollution, control the quantity of mineral substances and protect the soil and the underground waters.

Key words: pollution of the soil, the pollution moving through the soil, defines of the moving through the programme.

Introduction

The programme presented in the paper should show the filtration of the nitrogen and phosphate fertilizer through the sediments, and their contents in the depth. If we could calculate the contents of the nitrogen, phosphate and nitrates the soil depth, we could protect the soil by reducing the fertilizer that is used (G.L.E.A.M.S., 1987; Chapra, 1997; Miu and Kutzbach, 2007). Technological improvements that are intended to bring the land up to the better use of water, usually lead to loss of physical properties of soil. The combination of using heavy machinery and in the intensive irrigation can lead to serious land degradation problems (Montemurro, 2009). In addition to the use of water with enough sodium, inadequate use of fertilizers and pesticides leads to depletion of soil and chemical and biological (Musvoto et al., 2000; Van Der Zee and Boesten, 1991). By increasing the quantity of artificial fertilizer, the quantity of mineral substances which plants use is not going to increase: it will only increase the pollution of the soil and the pollution of the underground water (Mac Kirby et al., 2008; Bradley et al., 2005; Nilsen, 1986; Steven and Loheide, 2008; Van der Eijk et al., 2006; Eichler-Lobermann et al., 2007). Along with moving of water
through the sediments the polluted substances are moving too. By using this programme, we can define the contents of mineral substances through the depth of the soil and find the optimal solution that will not pollute the soil, but will give high yields of planted cultures.

One of the starting conditions that should be defined is the contents of the water in the soil. If we observe the soil as a reservoir for water, the contents of the water will depend on the height of free water and the depth of the soil. The soil that is moisturised naturally or artificially cannot hold more water than the value of the field capacity for that soil.

**Methodology**

**Contents of the water in the geological structure**

To define the contents of the water in the soil we start from the assumption that the quantity of the water in the soil is a known value which is obtained by a curve of the capillarity from the rising of the water. The definition of the contents of the water in the soil is a problem that depends on a lot of parameters. Their constant change, which depends on physical changes in nature and on the change of the season, is very complicated for continuous monitoring and uniform application in equations (GSF, 1997). Because of easier definition of the contents of water in the soil and the values which do not depend on physical changes in the nature, the contents of the water in the soil is, in the programme, defined by capillarity rising of water (Mansell and Rollet, 2006). The initial data for this programme is that capillary moving of water is different and depends on the structure of the soil. In order to determine the quantity of water in the soil the type of the soil has to be selected from the selection of several types in the programme: sand, clay etc. The next input is the selection of the level of underground water, where two options are offered.

Explanation of the moving of the water and its flow is performed by applying the equation of filtration given in the programme. In order to follow the infiltration we must enter the time of the rain as input information and the programme will calculate the intensity of the rain. In the programme the intensity of the rain is calculated by means of recurrent probability in the period of two years.

The biggest loss of the nitrogen and phosphate fertilizer on the surface of the soil and the filtration through it happens in autumn and winter months and in the beginning of the spring (Van der Zee and Van Riemsdijk, 1987). Then the soil is without vegetation and the quantity of the rain is increased. The programme is performing the review of the two different categories of the soil, for the sandy and clay soil. The programme defines the quantity of the water in the soil in every cm of its depth, from the surface of the soil to the underground water. By entering the information about the length of the rain the programme will determine the quantity of the rain.

An example for the sandy soil and the duration of the rain 20 min: the programme will determine the contents of the water, for instance in every 10 cm as follows (Figure 1):

The results for the sand are:
- at 10 cm 0.3664 cm³/cm³
- at 20 cm 0.4103 cm³/cm³
- at 30 cm 0.4057 cm³/cm³
- at 40 cm 0.3923 cm³/cm³
- at 50 cm 0.3873 cm³/cm³
- at 60 cm 0.3850 cm³/cm³
- at 70 cm 0.3810 cm³/cm³
- at 80 cm 0.3770 cm³/cm³
- at 90 cm 0.3738 cm³/cm³
- at 100 cm 0.3701 cm³/cm³

**Fig. 1. The moving of the water through the sand**
Analysing the output results we can conclude that the water front is moving up to 20 cm, when it comes to its maximum contents in the soil and the front is stopped. After that the filtering is slower, and the water front is moving slowly up to about 50 cm of depth. From 50 cm of the soil depth, the moving of the water is slower and the contents are reduced through the depth. The weakening of water front occurs because of the different structure of the soil, higher density of the soil and of the different contents of the water.

Contrary to the sandy soil, the clay soil has different structure, and it does not permeate much water, which is seen through the sediment moving in every cm of the depth. At 10 cm depth the quantity of the water is at its maximum. In the next steps the quantity of the water is lower since the permeability is slower. The clay soil structure causes the retention of large quantity of water, and what is filtrated is of low value, so that the reduction of the contents of the water is lower (Figure 2).

The results for the clay are:
- on 10 cm \(0.5803 \text{ cm}^3/\text{cm}^3\)
- at 20 cm \(0.5729 \text{ cm}^3/\text{cm}^3\)
- at 30 cm \(0.5648 \text{ cm}^3/\text{cm}^3\)
- at 40 cm \(0.5564 \text{ cm}^3/\text{cm}^3\)
- at 50 cm \(0.5478 \text{ cm}^3/\text{cm}^3\)
- at 60 cm \(0.5389 \text{ cm}^3/\text{cm}^3\)
- at 70 cm \(0.5297 \text{ cm}^3/\text{cm}^3\)
- at 80 cm \(0.5202 \text{ cm}^3/\text{cm}^3\)
- at 90 cm \(0.5104 \text{ cm}^3/\text{cm}^3\)
- at 100 cm \(0.5003 \text{ cm}^3/\text{cm}^3\)
- at 110 cm \(0.4898 \text{ cm}^3/\text{cm}^3\)
- at 120 cm \(0.4798 \text{ cm}^3/\text{cm}^3\)
- at 130 cm \(0.4790 \text{ cm}^3/\text{cm}^3\)
- at 140 cm \(0.4679 \text{ cm}^3/\text{cm}^3\)
- at 150 cm \(0.4564 \text{ cm}^3/\text{cm}^3\)

**Results and Discussion**

When the quantity of the water moving through the sediment is known, the quantity of nitrogen and phosphate fertilizer moving with the water can be defined (group of authors, 1992). To get the programme working, first we enter the data about the thrown fertilizer on the soil. In case of nitrogen fertilizer, the quantity of the nitrates and the quantity of the ammonia are calculated separately. The mixed portion and the portion which goes through the flowing are subtracted from the whole amount. Then we calculate the part with ammonia and nitrate that absorbs the clay fractions of the soil, and it stays on the surface. When we subtract those quantities from the whole quantity of the thrown fertilizer, we get the quantity that is the filtration component for ammonia, nitrate and phosphate. Those are the values calculated by the programme and they are marked as:

- PRNO - for nitrates
- PRNH - for ammonia
- PRLP - for phosphate

We have defined the moving of the water, and we know the filtrate component for ammonia, nitrate and phosphate. During the moving of the water through the sediment, the mineral matter is moving too. Using the equation for the filtration and the known values for the water, nitrogen and phosphate, the programme can calculate the contents of the mineral matter for the depth of the profile, to the underground water.

If, for example, the values of 480 kg/ha of nitrogen fertilizer and 400 kg/ha of phosphate fertilizer are entered the programme will calculate the following:

**For ammonia:**
- The quantity lost by the drain: \(\text{ONH}_4 = 1.3 \times 10^{-6} \text{ mg}\)
- The quantity which stays in strong phase: \(\text{NH}_4_{\text{sl}} = 2.59 \times 10^{-4} \text{ mg}\)
- The quantity that stays in the mixture: \(\text{NH}_4_{\text{wl}} = 1.8 \times 10^{-4} \text{ mg}\)

Filtrate component for ammonia: \(\text{PRNH} = 1.825 \text{ mg}\)

![Fig. 2. Moving of the water through the clay](image-url)
For nitrate:
The quantity lost by the drain
\( \text{ONO}_3 = 3.5 \times 10^{-5} \text{ mg} \)
The quantity that stays in strong faze
\( \text{NO}_3\l = 2.39 \text{ mg} \)
The quantity that stays in the mixture
\( \text{NO}_3\w = 5.04 \times 10^{-3} \text{ mg} \)
Filtrate component for nitrate
\( \text{PRNO} = 1.07 \text{ mg} \)

For phosphate:
The quantity lost by the drain
\( \text{OLP} = 4.7 \times 10^{-3} \text{ mg} \)
The quantity that stays in the mixture
\( \text{PLAB}_w = 0.67 \text{ mg} \)

Filtrate component for phosphate
\( \text{PRLP} = 0.117 \text{ mg} \)

The programme calculates the contents of mineral matters in the depth of the profile and their moving through it (Table 1).

Graphic of the contents of mineral matter in each 10 cm of the surface in the soil (Figure 3).

Conclusions

Two-thirds of agricultural land in India suffer the consequences of failure this year’s monsoon to bring rain. Only now becoming apparent unsustainability of modern agriculture (Green Revolution), which is based on fertilizers and monoculture (large area of land under the same vegetable culture) - because this land claims processing ten times more water from the ecological system of agriculture.

“Artificial fertilizers destroy wild life in the land which the land becomes vulnerable to drought. Mineral fertilizers also produce nitrogen oxides that are 300 times more dangerous for the climate (Potent) of carbon dioxide. Not only is agriculture which is based on mineral fertilizers and excessive water consumption leads to the exhaustion of underground water, but also destroys the (natural) soil fertility and contributes to climate change (“Climate Change, Drought and India’s looming Food and Water Crisis”). According to this
year’s report on the state of the environment (The State of the Environment report) - almost half the fertile land in India is affected by the process of degradation. The causes of this situation comes from soil erosion by wind and water erosion, as well as poor farmers’ practices: poor crop rotation practices and poor management of irrigation (excessive use of underground water that he came to renew), as well as excessive use of artificial fertilizers. The use of fertilizers has increased from 69.8 kg per hectare in 1991-92 to 113.3 kg per hectare in the 2006-07 year. In order to prevent negative trends farmers will have to reduce fertilizer usage and start using recycled water used previously (from industry or municipal sewage). Half India’s land degraded: agro-chemicals partly to blame.

In that way the programme can define the contents of mineral matter in the depth of the sediment. By defining the quantity of the mineral matter, we can protect the all geological structure from excessive pollution and enable the plants to grow normally. The programme can define the moving of the water, the filtrate component for ammonia, nitrate and phosphate. Control the quantity of mineral substances; we can protect the soil and the underground waters.

References


GSF National Research Centre for Environment and Health, 1997. UFIS-MODEL; University of CASSEL.

“Green Revolution of India”


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