



# **“DOMESTIC WASTE MANAGEMENT: COMPOSTING CONTROL BY OXYGEN CONTENT MEASUREMENT”**

**By**

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# Experimental section



Annual average temperature: 24.5 °C  
Annual precipitation: 1150 mm





**Composting operation**



# INTRODUCTION

- **Composting is an interesting approach for domestic waste management in developing countries**
- **Carbon financing, based on methane reduction, could participate to composting sustainability**
- **Methane emission for carbon financing is evaluated through specific methodology, including oxygen measurement**
- **In the industrial practice, the process is monitored only on the basis of temperature monitoring**



# BACKGROUND

**Composting is a natural, biological process of decomposition**

**Two main biological degradation processes:**

- Aerobic
- Anaerobic

**Oxygen content :**

- factors that determine organic matter composting process
- concentration should not get below 5 to 8% to avoid bacteria's asphyxia and methane production

**Anaerobic activity starts when oxygen concentration is below 10%**



# Process of composting

- ❑ **The main factors that influence the composting process:**
  - air (presence of oxygen)
  - water (humidity)
  - and nutrients (C/N ratio)
  
- ❑ **The windrow temperature is important, determining the variety of microbial species**
  
- ❑ **Temperature monitoring is an indirect measure of organics aerobic degradation**
  
- ❑ **The speed of oxygen transfer determines the speed of aerobic degradation**



# Process of composting

**• Windrow Oxygen content is the determining element for:**

- progress of aerobic biodegradation process,
- Nature and concentration of products

**• Measurement and supervision of oxygen concentration is thus very useful to bring air at the right time by turning over the pile**

# OBJECTIVE of STUDY

- This study is based on measures of oxygen concentration and temperature in piles by means of a multifunction combustion analyzer "SPRINT V2" by TELEGAN



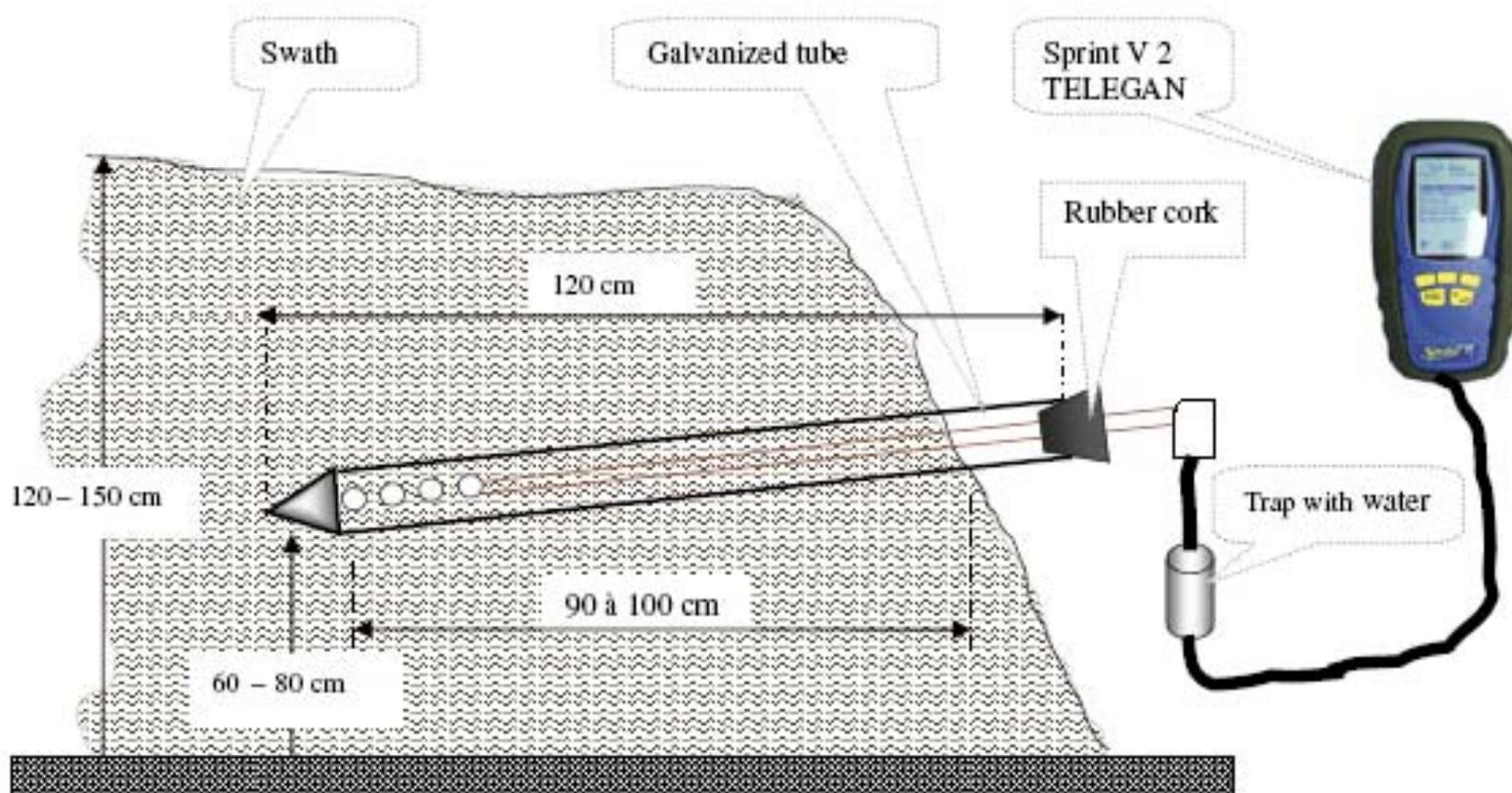
- The objective is to define a protocol to optimize the process.

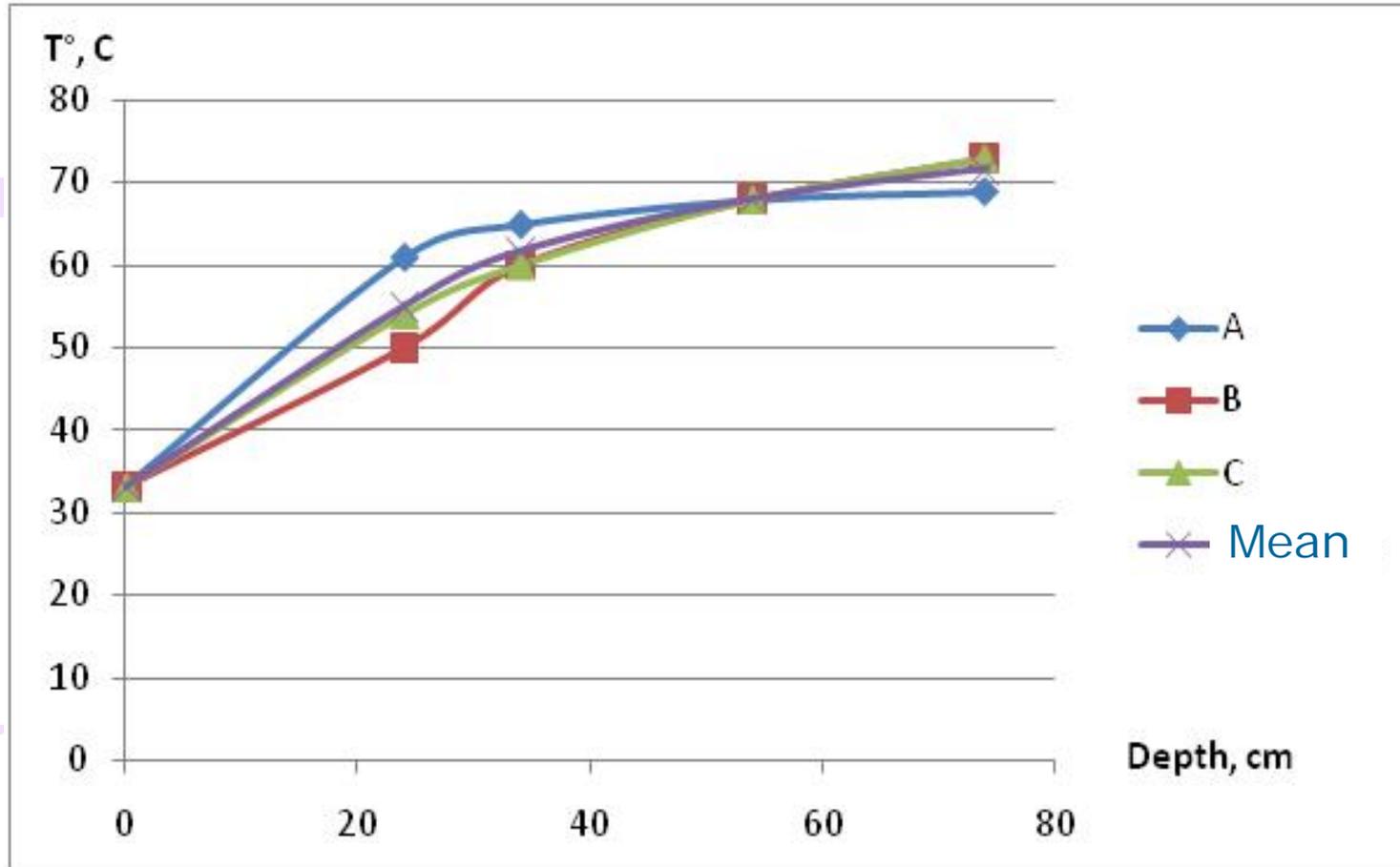
# Experimental section





# Experimental section





**Fig. 1. Temperature variation within the pile, according to measuring point depth**

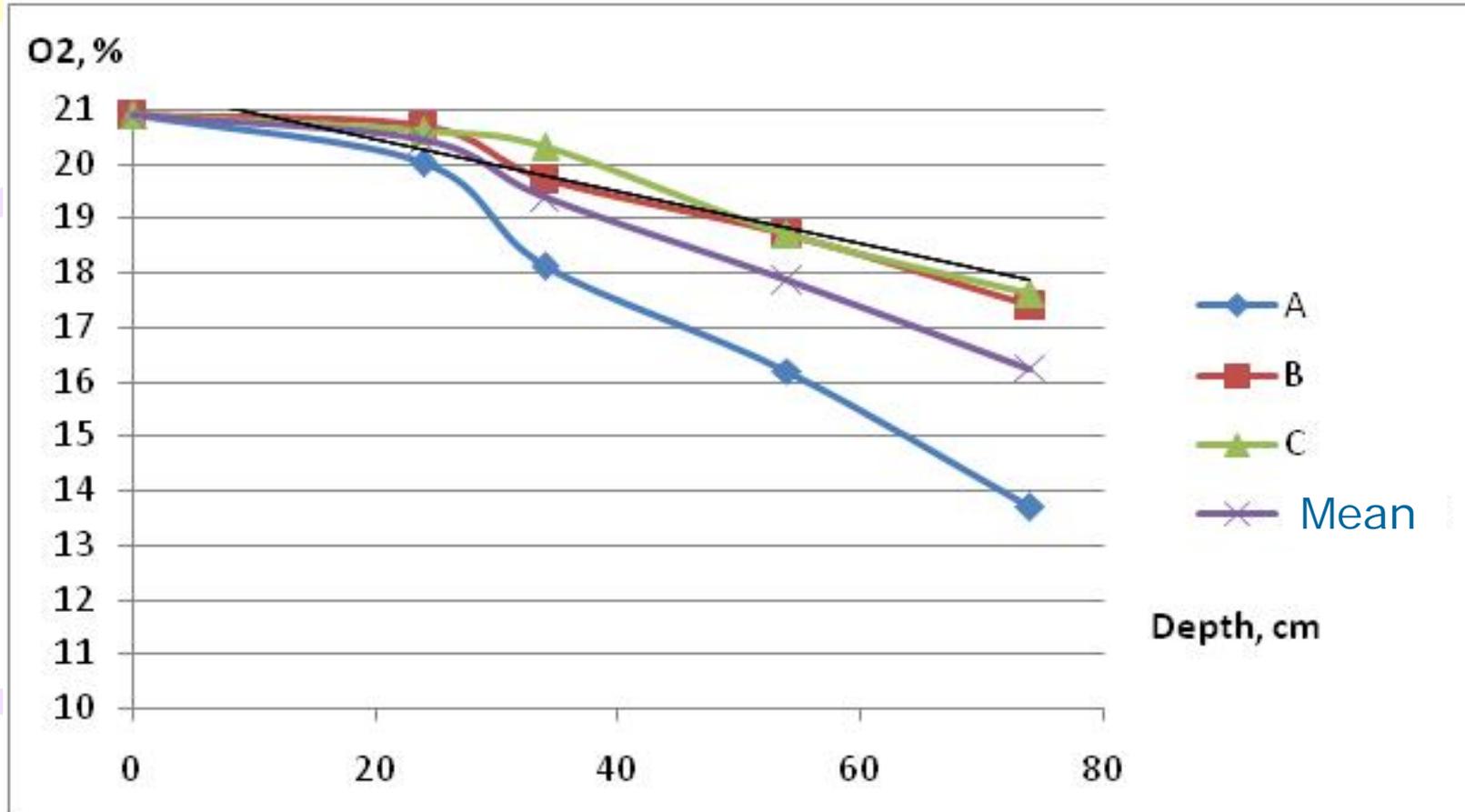
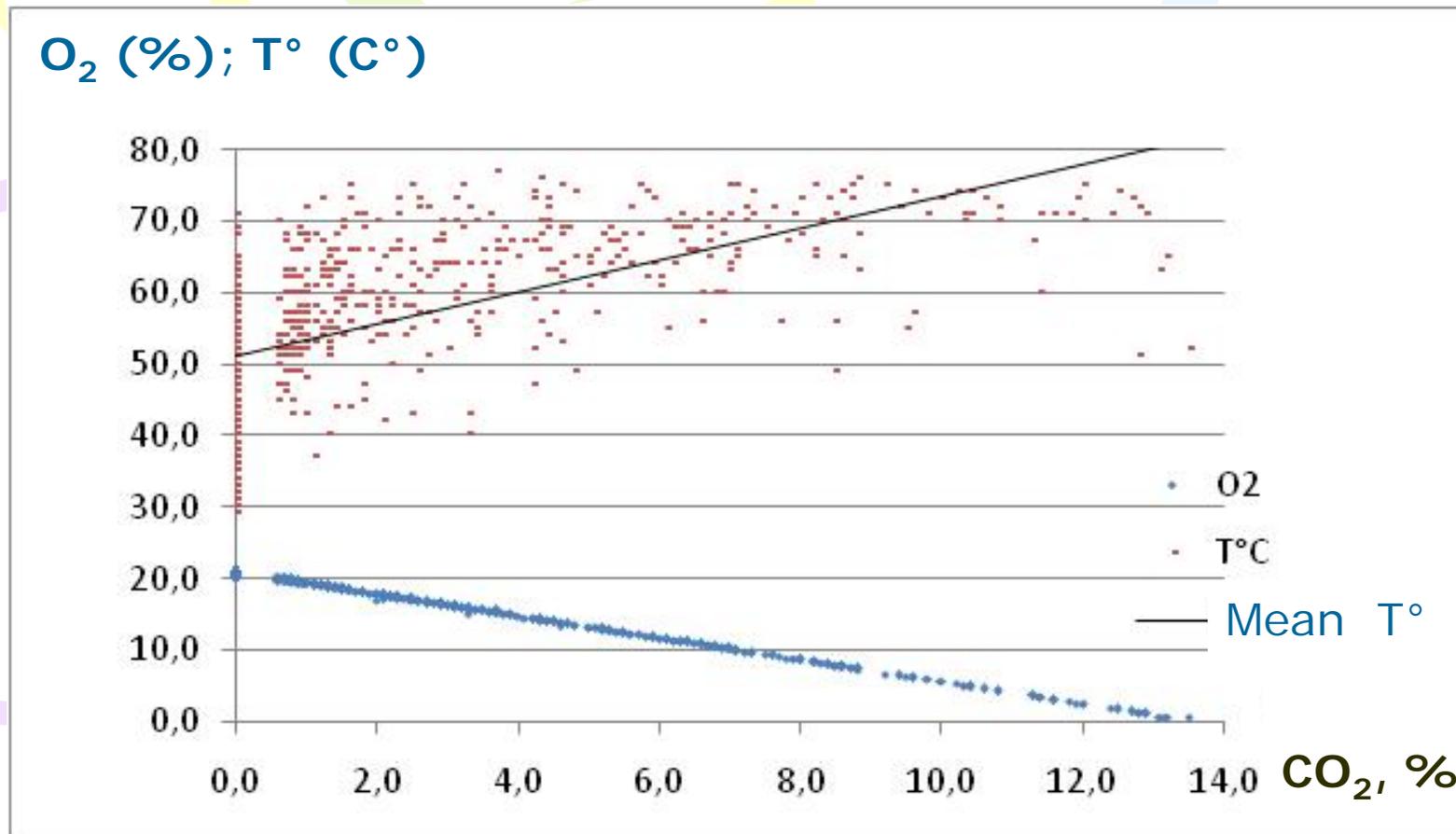
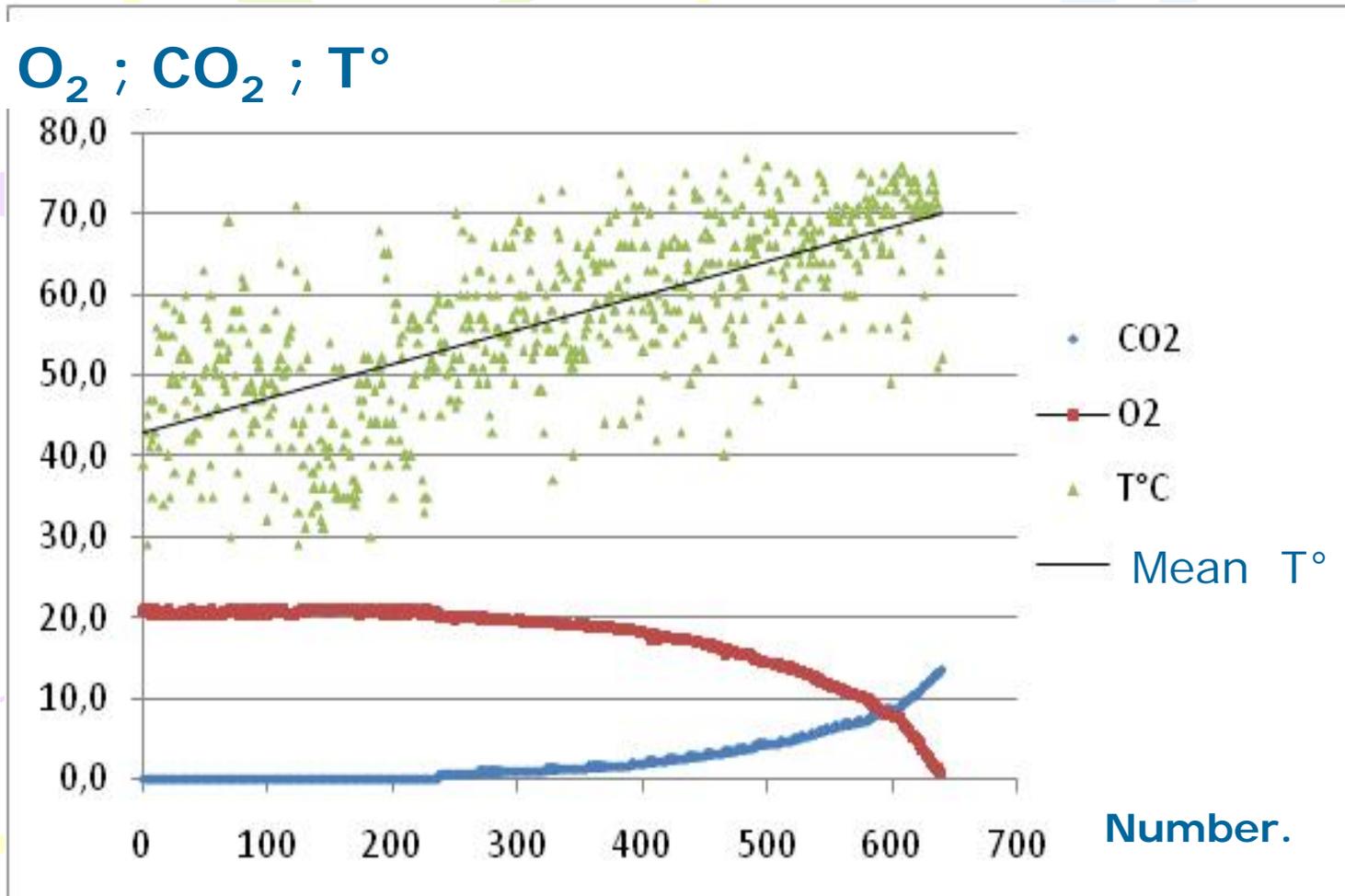


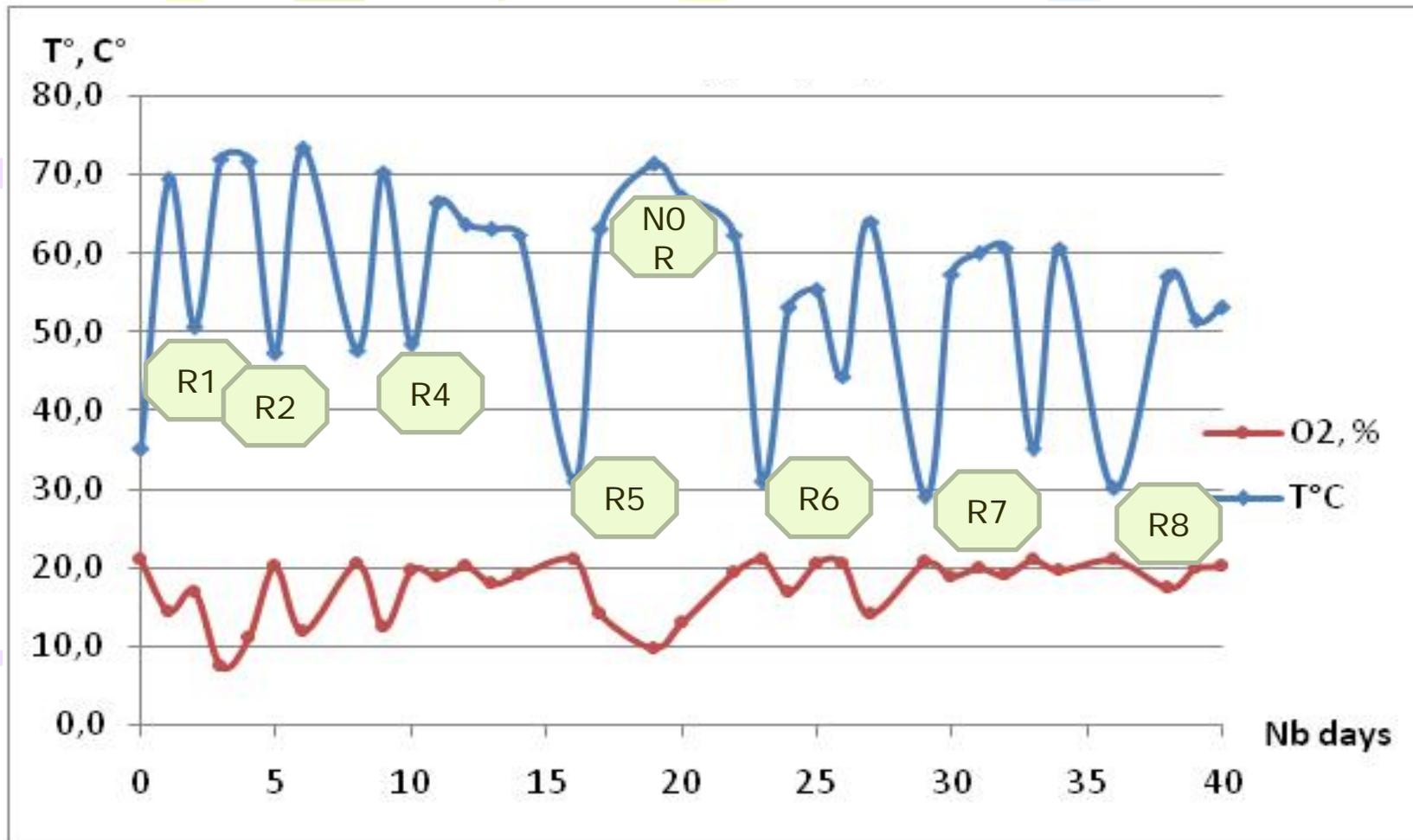
Fig. 2. Oxygen percentage variation within the pile, according to measuring point depth



**Fig. 3. Oxygen concentration and temperature variation, function of CO<sub>2</sub> concentration in the piles during composting**



**Fig. 4. Oxygen, CO<sub>2</sub> and temperature variation in the piles during composting**



**Fig 6.** Temperature and oxygen variation in city waste (except market) windrows

R5 = 5<sup>th</sup> turning over the pile



# DISCUSSION



- ❑ **Oxygen concentration and temperature may vary from one point of a windrow to another.**
- ❑ **This variation also depends on nature, size and porosity of organic waste**
- ❑ **During the three first days after the constitution of the windrow, oxygen concentration decreases considerably**
- ❑ **In this condition, temperature can get up to 80°C**
- ❑ **Oxygen concentration becomes more stable at the end of the process (maturation phase)**



# DISCUSSION



- ❑ **Frequency of turnovers and watering of piles determine oxygen concentration and temperature variation during composting**
- ❑ **Measuring oxygen concentration during composting guarantees the absence of methane emission**
- ❑ **If it can be demonstrated that oxygen content during this aerobic fermentation remains superior to 8 % deny of methane production is admitted**



# DISCUSSION



As a practical results of the study, the following pile turning (**n<sup>th</sup> R**) and watering (**A**) protocol could be defined

	1 R				2 R				3 R				4 R				5 R				6 R				7 R												
Hours	0	24	48	72	96	120	144	168	192	216	240	264	288	312	336	360	384	408	432	456	480	504	528	552	576	600	624	648	672	696	720						
			↻			↻				↻					↻						↻																↻
			A			A				A					A						A																A
Days	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	

*C + 2 days + R1 + 2 days + R2 + 2 days + R3 + 4 days + R4 + 6 days + R5 + 8 days + R6 + Maturation (20 in 30 days) = compost ( organic fertilizer)*

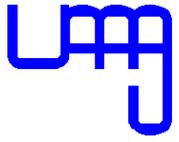
*(C = construction of the windrow; R1, R2, R3. = turnovers of pile for aeration, A = watering of windrows)*



# CONCLUSIONS



- **Results showed that temperature is high (60 to 75° C) during the first days**
- **Oxygen concentration, on the contrary, sharply decreases during the first phase**
- **Monitoring oxygen concentration in piles, allows avoiding a decrease of oxygen concentration below 8 %, considered as the critical value for methane production**
- **A diagram of piles turning is finally suggested**



# CONCLUSIONS

**Oxygen monitoring makes possible to optimize different factors, as length of composting process, manpower requirement and greenhouse gases reduction.**



# THANK YOU MI SAOTRA TOMPOKO (in Malagasy)



BIG BAOBAB



HOTEL DE VILLE



CATHEDRALE