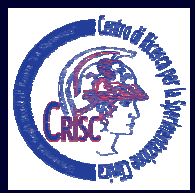
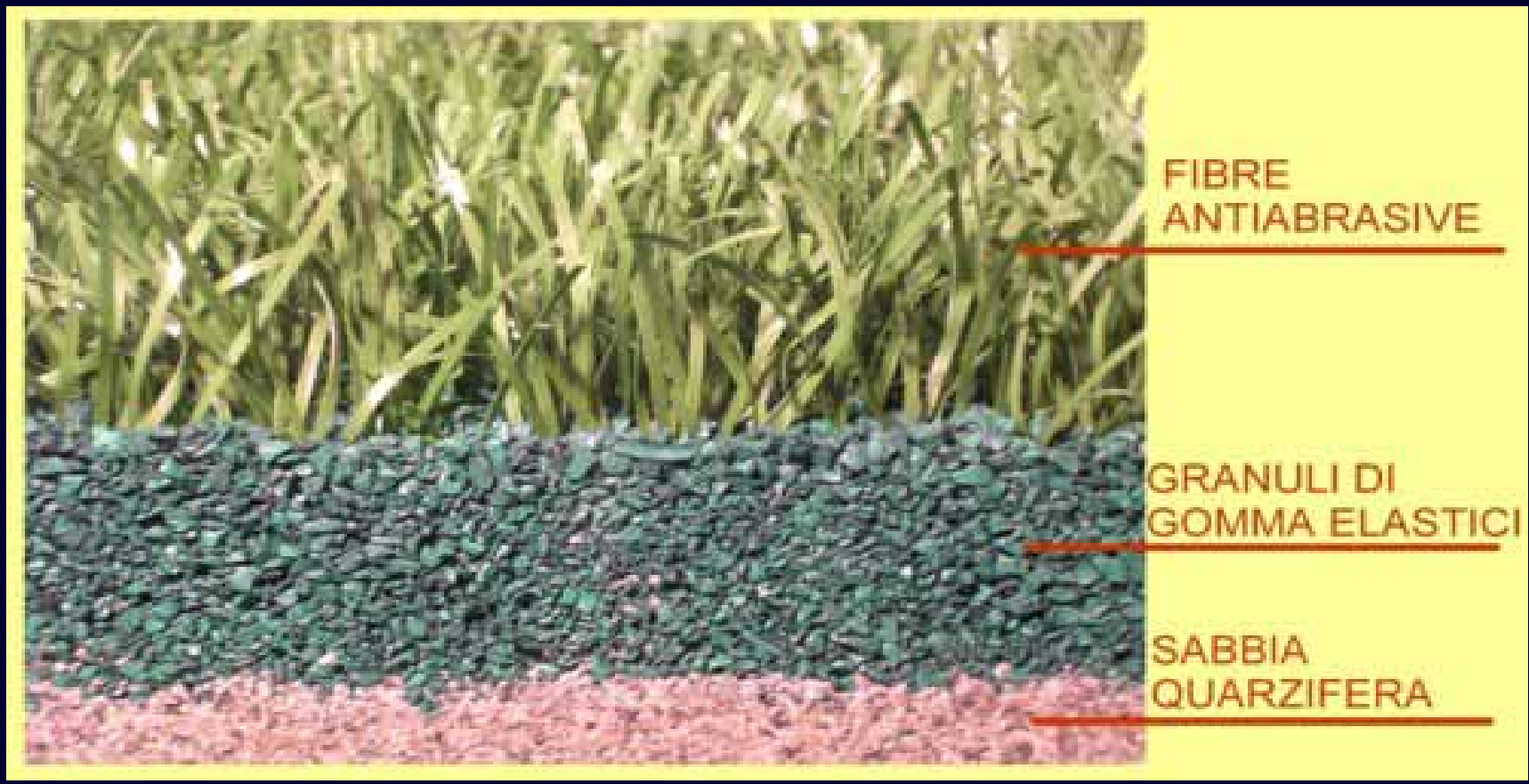
IS ARTIFICIAL TURF A PROBLEM? SITUATION IN ITALY AND PROSPECTIVE OF RESEARCH

Roberto Verna MD, PhD
Professor of Clinical Pathology
Director, Center for Clinical Research
University of Rome La Sapienza
Chairman, Committee for Artificial Turf Fields
Italian Ministry of Health

roberto.verna@uniroma1.it *web: w3.uniroma1.it/crisc*




FIBRE
ANTIABRASIVE
GRANULI DI
GOMMA ELASTICI
SABBIA
QUARZIFERA

The recent history

- April 2005 – Establishment of the FIGC Committee, Chaired by the President of the League of Amateurs (League D), Carlo Tavecchio.
- The novelty is the presence, in addition to the representatives of the different components of FIGC (League of Professional Players, League of Amateurs, Soccer Players, Coachs, Referees) of representatives of the Ministry for the Environment (Avv. Michela Corrado) and of the Ministry of Health (Prof. Roberto Verna).
- September 2005 – Report by Prof. Verna to the Minister of Health
- November 2005 – Establishment of the Committee for the Fields in Artificial Turf at the Ministry of Health

Committee for Fields of Artificial Turf established by act of the Ministry of Health 9.11.05

- Chairman: Prof. Dr. Roberto Verna – Director CRISC La Sapienza
- Secretary: Dott. Roberto Cursano – Administrative Specialist Ministry of Health
- Ministry of Health, Dir. Gen. Prevention: Dott. Pietro Pistolese
- Ministry of the Environment: Formerly Dott.ssa Aurelia Fonda, Actually Prof. Mauro Majone
- I.S.S.: Dott. Paolo Izzo, Dott. Leonello Attias
- CONI: Arch. Franco Vollaro, Dott. Maurizio Casasco
- ISPESL: Dott. Paola Castellano
- FIGC: Rag. Carlo Tavecchio
- Expert of Soccer Societies: Dott. Avv. Felice Mosè Pulici
- Ministry of Cultural Goods (as controller of CONI): Dott. Avv. Mario Antonio Scino. This Ministry has been replaced by the Ministry of Sport, whose representative is Dott. Roberta Innamorati
- Expert of the Ministry: Ing. Carlo Longhi
- ARGO: Dott. Ettore Musacchi

A CENTRAL QUESTION

ARE FIELDS IN ARTIFICIAL TURF DANGEROUS?

HOW TO ANSWER TO THIS PRINCIPAL QUESTION?

OUR FIRST NEED WAS TO ASSESS THE LIMITS OF DANGER

Due to the impossibility to perform in short times a complete research protocol, we had the need to refer to something already existing. The closest ordinance was:

G.U. n. 293 - 15-12-1999
(Supplement n. 218)
MINISTRY FOR THE ENVIRONMENT

- **ORDINANCE OF THE MINISTRY 25 october 1999, n.471**
  Rules to ensure polluted sites …….
  according to art 17 of the ordinance 5 february 1997, n. 22, …..

- ***All. 1***
- **Allowed limits of pollution…….**
- ***1. Maximal allowed concentration of contaminants according to the specific use……***

SOMMARIO

MINISTERO DELL'AMBIENTE

Tabella 1: Valori di concentrazione limite accettabili nel suolo e nel sottosuolo riferiti alla specifica destinazione d'uso dei siti da bonificare

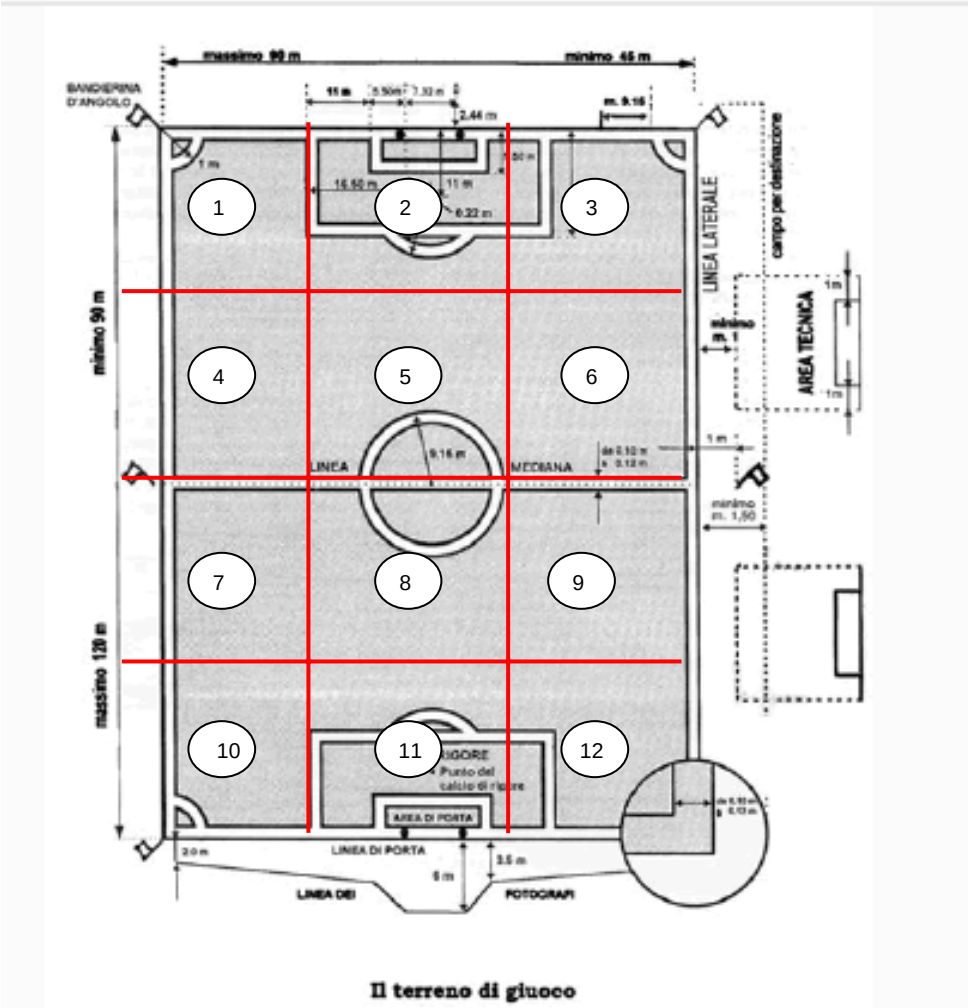
		A	B
		Siti ad uso Verde pubblico, privato e residenziale (mg kg^{-1} espressi come ss)	Siti ad uso Commerciale e Industriale (mg kg^{-1} espressi come ss)
	Composti inorganici		
1	Antimonio	10	30
2	Arsenico	20	50
3	Berillio	2	10
4	Cadmio	2	15
5	Cobalto	20	250
6	Cromo totale	150	800
7	Cromo VI	2	15
8	Mercurio	1	5
9	Nichel	120	500
10	Piombo	100	1000
11	Rame	120	600
12	Selenio	3	15
13	Stagno	1	350
14	Tallio	1	10
15	Vanadio	90	250
16	Zinco	150	1500
17	Cianuri (liberi)	1	100
18	Fluoruri	100	2000
	Aromatici		
19	Benzene	0.1	2
20	Etilbenzene	0.5	50
21	Stirene	0.5	50
22	Toluene	0.5	50
23	Xilene	0.5	50
24	Sommatoria organici aromatici (da 20 a 23)	1	100
	Aromatici policiclici 1		
25	Benzo(a)antracene	0.5	10
26	Benzo(a)pirene	0.1	10
27	Benzo(b)fluorantene	0.5	10
28	Benzo(k,)fluorantene	0.5	10
29	Benzo(g, h, i,)perilene	0.1	10
30	Crisene	5	50
31	Dibenzo(a)pirene	0.1	10
32	Dibenzo(a,h)antracene	0.1	10
33	Indenopirene	0.1	5
34	Pirene	5	50
35	Sommatoria policiclici aromatici (da	10	100

Prof. Roberto Verna

	25 a 34)		
	Alifatici clorurati cancerogeni [1]		
36	Clorometano	0.1	5
37	Diclorometano	0.1	5
38	Triclorometano	0.1	5
39	Cloruro di Vinile	0.01	0.1
40	1,2-Dicloroetano	0.2	5
41	1,1 Dicloroetilene	0. 1	1
42	1,2-Dicloropropano	0.3	5
43	1,1,2-Tricloroetano	0.5	15
44	Tricloroetilene	1	10
45	1,2,3-Tricloropropano	0. 1	1
46	1,1,2,2-Tetracloroetano	0.5	10
47	Tetracloroetilene (PCE)	0.5	20
	Alifatici clorurati non cancerogeni [1]		
48	1,1-Dicloroetano	0.5	30
49	1,2-Dicloroetilene	0.3	15
50	1,1,1-Tricloroetano	0.5	50
	Alifatici alogenati Cancerogeni [1]		
51	Tribromometano (bromoformio)	0.5	10
52	1,2-Dibromoetano	0.01	0.1
53	Dibromoclorometano	0.5	10
54	Bromodiclorometano	0.5	10
	Nitrobenzeni		
55	Nitrobenzene	0.5	30
56	1,2-Dinitrobenzene	0.1	25
57	1,3-Dinitrobenzene	0.1	25
58	Cloronitrobenzeni	0.1	10
	Clorobenzeni [1]		
59	Monoclorobenzene	0.5	50
60	Diclorobenzeni non cancerogeni (1,2-diclorobenzene)	1	50
61	Diclorobenzeni cancerogeni (1,4 – diclorobenzene)	0.1	10
62	1,2,4 -triclorobenzene	1	50
63	1,2,4,5-tetraclorobenzene	1	25
64	Pentaclorobenzene	0.1	50
65	Esaclorobenzene	0.05	5
66	**Fenoli non clorurati** [1]		
67	Metilfenolo (o-, m-, p-)	0.1	25
68	Fenolo	1	60
	Fenoli clorurati [1]		
69	2-clorofenolo	0.5	25
70	2,4-diclorofenolo	0.5	50
71	2,4,6 - triclorofenolo	0.01	5
72	Pentaclorofenolo	0.01	5

	Ammine Aromatiche[1]		
73	Anilina	0.05	5
74	o-Anisidina	0.1	10
75	m,p-Anisidina	0.1	10
76	Difenilamina	0.1	10
77	p-Toluidina	0.1	5
78	Sommatoria Ammine Aromatiche (da 73 a 77)	0.5	25
	Fitofarmaci		
79	Alaclor	0.01	1
80	Aldrin	0.01	0.1
81	Atrazina	0.01	1
82	α-esacloroesano	0.01	0.1
83	β-esacloroesano	0.01	0.5
84	γ-esacloroesano (Lindano)	0.01	0.5
85	Clordano	0.01	0.1
86	DDD, DDT, DDE	0.01	0.1
87	Dieldrin	0.01	0.1
88	Endrin	0.01	2
	Diossine e furani		
89	Sommatoria PCDD, PCDF (conversione T.E.)	$1x10^{-5}$	$1x10^{-4}$
90	PCB	0.001	5
	Idrocarburi		
91	Idrocarburi Leggeri C<12	10	250
92	Idrocarburi pesanti C > 12	50	750
	Altre sostanze		
93	Amianto (fibre ~~libere~~)	1000*	1000*
94	Esteri dell'acido ftalico (ognuno)	10	60

RESEARCH PROTOCOL



Il terreno di giuoco

Il campo è stato suddiviso in 12 rettangoli regolari che sono stati numerati.
Il prelievo dei campioni (esclusivamente granulato) è stato effettuato al centro di ogni rettangolo.
La quantità di granulato prelevata consiste in tre sacchetti da circa 250 grammi di granulato l'uno per un totale di circa 750 grammi di granulato prelevati per ogni rettangolo.
Un sacchetto è stato consegnato alla società proprietaria del campo che dovrà custodirlo.
Gli altri due sacchetti sono stati consegnati all'ISS.

TYPE	LOCATION
A: Thermoplastic, virgin	Firenze
B: Thermoplastic virgin	Mentana (RM)
C: Compound con polverino di pneumatico post-uso nobilitato per estrusione	Ancona
D: Recycled – Tyre granules after use, ennobled	Vittuone (MI)
E: Recycled – Tyre granules after use	Roma
F: Recycled – Granuli di scarto tecnico di gomma vulcanizzata per altri utilizzi	F1 Guidonia Montecelio (RM) F2 Riccione (RN)
G: Recycled – Tyre granules after use	G1 Roma G2 Santa Croce (AV)
H: Recycled – Tyre granules after use	Torino
I: Recycled – Mix of Triturazione di vguarnizioni	Capua
L: Recycled – Mix of	Roma
M: Recycled – Mix of	Roma

RESULTS

Indagine Intaso di campi di calcio in erba sintetica															
N°	Analiti	Limiti DM 471/1999 (All.1 - Tab.1 - Col.A) (mg/Kg ss)	Campo A	Campo B	Campo C	Campo D	Campo E	Campo F	Campo F 1	Campo G	Campo G 1	Campo H	Campo I	Campo L	Campo M
	Composti inorganici														
	Alluminio		1,2	6680	1028	490	164	3260	311	477	755	230	4884	2065	5922
1	Antimonio	10	0,34	7,75	1,62	6,39	0,52	1,23	3,59	1,06	0,46	0,53	1,07	0,65	2,69
2	Arsenico	20	0,14	0,94	0,24	0,12	0,41	1,21	0,11	0,13	0,10	0,10	0,54	0,28	0,37
	Bario		4,39	3485	4,72	741	2,38	31,1	10,0	5,34	23,4	4,96	4778	27,9	21,9
3	Berillio	2	0,001	0,11	0,036	0,007	0,012	0,37	0,006	0,016	0,036	0,008	0,15	0,063	0,21
4	Cadmio	2	0,11	0,37	0,12	1,87	1,89	0,30	0,17	1,09	0,62	1,72	0,17	1,06	0,34
5	Cobalto	20	<0.5	26,8	5,0	234	116	4,1	3,5	33,3	8,8	57,8	9,9	8,4	20,9
6	Cromo totale	150	48,6	56,0	1,8	6,2	<0.3	6,2	<0.3	0,4	4,6	1,2	20,3	2,5	18,3
7	Cromo VI	2													
	Ferro		14,6	4318	201	465	199	637	183	291	620	305	460	241	403
	Litio		4,29	4,14	7,39	0,60	1,44	11,1	2,71	1,42	1,08	0,87	1,02	1,48	4,42
	Magnesio		470	456	668	966	235	518	186	280	653	465	286	253	123
	Manganese		5,2	29,6	5,2	4,9	3,0	10,0	6,2	4,4	3,6	3,8	15,5	3,8	8,3
8	Mercurio	1	<0.02	0,05	0,08	0,07	0,05	0,06	0,03	0,16	0,06	0,07	0,09	<0.02	0,1
	Molibdeno		0,04	2,08	0,09	0,13	0,12	0,19	0,11	0,18	0,29	0,18	0,34	6,56	0,30
9	Nichel	120	0,67	1,46	0,67	5,75	2,48	4,40	0,61	1,25	1,92	2,03	5,46	2,38	3,25
10	Piombo	100	45,9	42,8	<0.7	27,6	25,5	13,7	<0.7	22,1	12,0	22,4	34,5	17,0	13,7
11	Rame	120	0,8	54,5	11,6	59,5	22,3	5,9	13,4	16,0	8,7	19,9	6,3	11,5	3,4
	Rubidio		0,65	12,5	3,04	1,80	3,10	25,7	0,78	1,31	0,90	1,22	1,71	1,46	2,18
12	Selenio	3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
13	Stagno	1	0,12	2,46	0,58	1,74	2,00	3,04	0,32	0,79	0,65	2,44	1,19	0,98	1,43
	Stronzio		16,7	90,4	19,3	11,9	3,82	17,5	9,95	5,96	5,34	3,16	86,5	6,93	13,2
14	Tallio	1	0,02	0,09	0,03	0,07	0,14	0,21	0,01	0,06	0,04	0,05	0,17	0,09	0,03
	Tungsteno		0,02	0,84	0,36	0,07	0,06	1,84	0,13	0,06	0,12	0,06	0,79	0,15	0,74
15	Vanadio	90	0,38	2,40	1,47	1,46	2,20	9,63	0,94	1,35	3,52	1,39	21,6	9,70	22,4
16	Zinco	150	118	6813	1063	19375	17772	7611	1408	12274	10229	13781	10910	14187	9488
17	Cianuri (liberi)	1													
18	Fluoruri	100													
	Aromatici														
19	Benzene	0,1	<0.001	<0.001	<0.001	<0.001	<0.001	1,04	<0.001	<0.001	<0.001	<0.001	0,95	<0.001	<0.001
20	Etilbenzene	0,5	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
21	Stirene	0,5	<0.01	0,73	1,31	0,97	<0.01	0,42	0,14	0,13	0,83	0,94	1,97	<0.01	1,14
22	Toluene	0,5	4,1	3,3	0,72	2,15	9,6	7,7	1,18	1,2	72,3	2,1	6,11	8	40,4
23	Xilene	0,5	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
23	Σ organici aromatici (20 a 23)	1													

Indagine Intaso di campi di calcio in erba sintetica															
N°	Analiti	Limiti DM 471/1999 (All.1 - Tab.1 - Col.A) (mg/Kg ss)	Campo A	Campo B	Campo C	Campo D	Campo E	Campo F	Campo F 1	Campo G	Campo G 1	Campo H	Campo I	Campo L	Campo M
	Aromatici policiclici														
25	Benzo(a)antracene	0,5	0,001	0,286	0,044	0,146	0,207	0,140	0,209	0,433	0,328	0,356	0,088	0,185	0,008
26	Benzo(a)pirene	0,1	<0.001	0,049	0,060	2,300	3,035	0,770	0,066	10,695	1,187	1,380	0,721	2,834	0,021
27	Benzo(b)fluorantene	0,5	0,001	0,030	0,050	0,462	0,439	0,332	0,080	1,776	0,267	0,386	0,231	0,438	0,015
28	Benzo(k)fluorantene	0,5													
29	Benzo(ghi)perilene	0,1	0,008	0,276	0,246	8,363			0,457		29,209		9,024		0,250
30	Crisene	5	0,013	1,433	0,992	0,974	0,804	1,343	0,500	2,375	0,649	1,513	0,459	0,669	0,029
31	Dibenzo(a)pirene	0,1													
32	Dibenzo(ah)antracene	0,1	<0.001		0,035										
33	Indenopirene	0,1	0,001	0,085	0,052	1,079			0,069		3,733		1,257		0,037
34	Pirene	5	0,017	1,510	0,416	15,141	2,768	0,443	0,204	1,863	9,743	4,480	11,156	5,631	0,753
35	Σ(25-34) policiclici aromatici	10	0,040	3,670	1,895	28,464	7,254	3,027	1,585	17,143	45,117	8,115	22,936	9,757	1,113
	Alifatici clorurati cancerogeni														
36	Clorometano	0,1	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
37	Diclorometano	0,1	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
38	Triclorometano	0,1	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
40	Cloruro di vinile	0,01	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015
41	1,2-dicloroetano	0,2	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
42	1,1-dicloroetilene	0,1	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
43	1,2-dicloropropano	0,3	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
44	1,1,2-tricloroetano	0,5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
45	Tricloroetilene	1	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
46	1,2,3-tricloropropano	0,1	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
47	1,1,2,2-tetracloroetano	0,5	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
48	Tetracloroetilene (PCE)	0,5	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
	Alifatici clorurati non cancerogeni														
49	1,1-dicloroetano	0,5	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
50	1,2-dicloroetilene	0,3	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
51	1,1,1-tricloroetano	0,5	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	Nitrobenzeni														
55	Nitrobenzene	0,5	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
56	1,2-dinitrobenzene	0,1	<0,6	<0,6	<0,6	<0,6	<0,6	<0,6	<0,6	<0,6	<0,6	<0,6	<0,6	<0,6	<0,6
57	1,3-dinitrobenzene	0,1	<0,8	<0,8	<0,8	<0,8	<0,8	<0,8	<0,8	<0,8	<0,8	<0,8	<0,8	<0,8	<0,8
58	Cloronitrobenzeni	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
	Clorobenzeni														
59	Monoclorobenzene	0,5	<0,6	<0,6	<0,6	<0,6	<0,6	<0,6	<0,6	<0,6	<0,6<	<0,6	<0,6	<0,6	<0,6
60	Diclorobenzeni non cancerogeni (1,2-diclorobenzene)	1	<0,09	<0,09	<0,09	<0,09	<0,09	<0,09	<0,09	<0,09	<0,09	<0,09	<0,09	<0,09	<0,09
61	Diclorobenzeni cancerogeni (1,4-diclorobenzene)	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
62	1,2,4-triclorobenzene	1	<0,9	<0,9	<0,9	<0,9	<0,9	<0,9	<0,9	<0,9	<0,9	<0,9	<0,9	<0,9	<0,9
63	1,2,4,5-tetraclorobenzene	1	<0,02	<0,02	<0,02	<0,02	<0,02	<0,02	<0,02	<0,02	<0,02	<0,02	<0,02	<0,02	<0,02
64	Pentaclorobenzene	0,1	<0,07	<0,07	<0,07	<0,07	<0,07	<0,07	<0,07	<0,07	<0,07	<0,07	<0,07	<0,07	<0,07

SUMMARY OF THE RESULTS

- All the fields, except one, result full of Zn and of other heavy metals
- A large part show the presence of APH in significant amount
- Aromatic compounds are also present.
- ***All these substances are considered Cancerogens, Mutagens, Toxic***

What to do, then?

A new research protocol

Such a protocol should be:

- able to assess the risk in the different conditions of use
- rapid and not expensive
- reliable

Preliminary information to acquire for any single typology of field before the environmental and biological monitorings

- **type of the filling;**
- **characteristics of the field (dimensions, age, positioning regarding roads or high density of traffic, etc.);**
- **number of assigned that usually work on the field (es.maintenance of the field, trainers etc.) with description of the activities and timetable of job for every type of activity;**
- **number of athletes who attend the field and timetable of permanence;**
- **general information (such as post-working activities, smoking etc.) for the subjects that will undergo to the biological monitoring obtained by means of compilation of an appropriate questionnaire after delivery of a module for the informed consent.**

Samplings and analysis to run for each field

- Aromatic Hydrocarbons (Benzene, Toluene, Xylene, Ethylbenzene, Styrene etc.)
- Aromatic Policyclic Hydrocarbons
- Metals (Pb, Cd, Cr, Sn, Zn)
- Aromatic Amines (fenilendiammine)
- Ftalates
- For the evaluation of the professional exposure the reference value will be the rules established by the current legislation for the protection of professionally exposed workers (D.Lgs 66/00 for benzene and D.Lgs 25/02 for lead)

- Examination, for each field, of eventually existing data (or acquisition of experimental data) for the evaluation of the presence and the concentration of some of the aforesaid polluting substances in the location under examination

- *The aim is to evidence the real contribution due to emissions coming from the filling material of the fields in artificial turf.*

Samplings of people acting on every field (Laboratory of Toxicological Chemistry - I.S.P.E.S.L.)

To skip the difficulty to use personal samplers on athletes, trainers etc. (in consideration of the sport activity), these could be placed in various representative zones during a specific activity (example: during training)

It will be important to place a sampling point outside of the field, in order to evidence the contribution of further sources of emission.

The samplings will be run to monitorate all the period of the activity carried out (e.g. by the trainers) along the day span.

- In consideration of the variability of the concentrations of the polluting substances tied to the climatic and meteorological conditions, is thought opportune to repeat the campaign of the samplings in two periods of the year characterized by significantly different average values of the temperatures: autumn-winter and spring - summer.
- For every period there will be carried out at least three days of representative sampling (e.g. raining day, sun, wind etc.).

Procedural protocol for the biological monitoring on urine samples to assess the exposure to benzene and Aromatic Policyclic Hydrocarbons.
Part I

- Evaluation of the amount effectively absorbed from the single subjects by biological monitoring.

Marker: S- fenil-mercapturic acid (SPMA) in urines (treshold limit 25micrograms per gram of creatinine).

It is necessary to carry out the determination also at the beginning of the turn of job as control.

Procedural protocol for the biological monitoring on urine samples to assess the exposure to benzene and Aromatic Policyclic Hydrocarbons.
Part Ia

- For the monitoring of the exposure to low and mean benzene concentrations, the cigarette smoke is an important confusion factor (in the urine of the smokers, concentrations of SPMA up to 65 micrograms per gram of creatinine have been found) and therefore the biological monitoring is meaningful only on not smokers subjects.

Procedural protocol for the biological monitoring on urine samples to assess the exposure to benzene and Aromatic Policyclic Hydrocarbons.
Part II

- For each subject considered, two urine champions are necessary. One before the beginning of the turn and one to the end of the same, collected in suitable containers.

Marker of the exposure to Aromatic Policyclic Hydrocarbons (IPA) is the urinary 1-idrossipirene (1-OH-Py), metabolite of the pyrene always present in IPA mixtures but not cancerogenous, even if for it a limit value has not been established yet.

Measurements

1-idrossipirene is measured at the end of the last turn of job of the working week because of its long halflife (from 6 to 35 hours, average 18 hours);

- since IPA are produced also by the vehicular traffic, by smoke and by combustion processes, the basal values of the subject undergone to the monitoring will not be zero. Therefore it is necessary to run the measurement of the marker also before the beginning of the working week, and if possible in a group of subjects not professionally exposed, as control group. Also for this marker, in the case of exposure to low doses, the monitoring is meaningful only for not smoking subjects.

Sampling (1)

- Urine samples must be taken before the beginning of the turn of job and at the end of such turn for at least three consecutive days (one single operator is enough), in suitable containers, clearly identifying the worker (eventually with a code) indicating the day and the hour of the withdrawal.

Sampling (2)

- On all the champions a marker of exposure to benzene will be measured:

S-Phenyl-Mercapturic Acid (SPMA)

- On the samples of the starting turn of the first day and of the final turn of the last day the marker of exposure to IPA will be measured:

Urinary hydroxypyrene

Sampling (3)

- On all the samples the concentration of creatinine will be measured in order to express the result independently from the degree of urine dilution.

Sampling (4)

- In order to better estimate the casual (not due to specific work) environmental exposure, it could be useful to analyse random samples of urine of a control population

As controls one can consider 5 to 10 persons, not smokers, living or working in the same zone but not directly on the fields object of the study.

Sampling (5)

- A questionnaire for the collection of the necessary information will be distributed to the workers (together with the informed consent).
- The analyses will be carried out in the Laboratory of Biochemistry Applied to Job (I.S.P.E.S.L.) with methods sensitive and highly specific such as HPLC/MS/MS for the substances under analysis.
- In order to estimate the effect of the climatic conditions, the sampling campaign must be repeated in two periods of the year with meaningfully various medium temperatures (autumn-winter and spring - summer).

Proposal for the evaluation of the possible environmental contamination deriving from the use of plastic granulates (virgin or recycled from tyres) as filling for fields in synthetic turf

- On the basis of the tests already carried out and of the scientific literature available (e.g. Norvegian Institute for Water Research, NIVA LNR5111-2005), a deepening of the evaluation of the possible contamination of grounds and below waters due to the use of the aforesaid materials seems necessary.

Evaluation protocol

Leaching test on the filling materials (either collected from soccer fields in use or supplied from the producers) to estimate the intrinsic tendency to the release of chemical substances from the filling materials

- According to the results it will be choosen the execution of:
- a) analysis of risk in various scenes of exposure and/or
- b) execution of surveys on the land and waters under the fields.

Max Concentrations Allowed

Test or limit Meaning	DM 5/4/06, all. 3 Allowance of particular stuff on remainder in simplified procedure	DIN Sports Grounds Part 7, Synthetic Turf Areas, Determination of Environmental Compatibility	Tab 2 All 5 D.Lgs. 152/06 Max Conc in subterranean water
Matrix	Deion Water	Deioniz Water	
Ratio liquid/solid	10	10	
Time (h)	24	24	
Extract analyzed	I extraction	II extraction	
Parametres			
mg/l NO3	50		
mg/l F	1,5		1.5
mg/l SO4	250		250
mg/1 Cl	100		
Micrograms/l Cn	50		50
mg/l Ba	1		
mg/l Cu	0.05		1
mg/l Zn	3	0.5 (deioniz)3 (acid for CO_2)	3
Microgr/l Be	10		4
micrograms/l Co	250		50
Micrograms/l Ni	10		20
Micrograms/l V	250		
microgrammi/l As	50		10
Micrograms/l Cd	5	5	5
Micrograms/l Cr	50	50	50
micrograms/l Cr(VI)		8	5
Micrograms/l Pb	50	40	10
Micrograms/l Se	10		10
Micrograms/l Hg	1	1	1
micrograms/l Sn		50	
Amiant mg/l	30		
COD mg/l	30	20 (as DOC)	
pH	5,5 < > 12,0		

THANK YOU FOR YOUR ATTENTION