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CAPACITY SITUATION IN SPANISH RESERVOIRS (*)

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1. INTRODUCTION

In 1967, the Centro de Estudios y Experimentación de Obras Públicas (CEDEX) was commissioned by the Dirección General de Obras Hidráulicas (Hydraulic Works Administration) to carry out a bathymetric survey of a series of reservoirs situated in the upper reaches of river basins, in which the development of erosion processes could affect their useful life.

Fieldwork and laboratory work has been undertaken since 1980, with a view to determining the sediment texture, and thus its average density.

When the results from several reservoirs had been collected and analysed, it could be observed that other factors, in addition to the slope, could have a considerable effect on the solid yield in the reservoirs. An

(*) *Situation de la capacité des réservoirs espagnols.*

example of such factors is the question of anthropic activity (fields no longer cultivated, ploughing, forest clearance,...).

As a result of these and other findings, the original plan was extended to include studies of reservoirs that were suggested by the different River Authorities, given that these bodies are in the best position to understand the problems of their own basins.

At present, the aim of the work is to update the reservoir capacity curves and measure the volumes of the deposited material.

2. METHODOLOGY FOR MEASURING RESERVOIR SILTING

2.1. Updating the capacity curves

Knowing the initial capacity is the starting point for determining reservoir silting. This value, which " a priori " would appear to be easy to obtain, is almost impossible to get for some reservoirs, especially when dam construction took place many years ago, because information is incomplete and/or unreliable. It should be borne in mind, that the development of photogrammetric techniques in Spain took place in the late fifties.

The other vital piece of information, is to know the reservoir capacity at a specific point in time.

The difference between both volumes (initial/survey), indicates the sediment volume that has entered the reservoir and settled on the bed, up to the initiation of the survey.

Normally, depending on the management system, reservoirs are only full/empty for a short period of time.

Two complementary procedures, photogrammetry and bathymetry, are generally used to obtain the reservoir curve capacity.

Firstly, aerial mapping of the reservoir basin is carried out to a predetermined scale. Once the photography has been obtained, it is used for fieldwork, and a topographical plan (levelling, plane surveying) is drawn up for the land lying above the water surface on the flight day.

The part of the reservoir basin that cannot be plotted because it was submerged on the day of the aerial photography, has to obtained through bathymetric surveys.

A plan of the reservoir is thus obtained on the basis of the chosen contours. The surface area enclosed by each contour has to be calculated so that the reservoir storage capacity can be determined. A digitised panel connected to a computer with the necessary calculation programs, is used for this purpose.

The elevations-surfaces-accumulated volumes table is calculated with the aid of the above-mentioned equipment and the elevation-surface data obtained by digitisation of the sheets that constitute the reservoir plan. The volume for the Normal Water Storage (NWS) considered, defines the reservoir capacity.

2.2. Reservoir sedimentology studies. Sediment texture

The basic aim of sedimentological surveys in reservoirs, is to calculate the sediment density, so that the volumes deposited, as obtained from bathymetric studies, can be transformed into units of weight, because the volumes evolve and change in time.

The main factors that affect sediment density are :

- The size of the sediment particles (texture).
- The reservoir management system.
- The degree of sediment compaction.

The factor about which least is known, is the first of these, so the meaning is outlined below.

– Sediment texture

Detrital sediment size-distribution has been the subject of numerous studies, it having been shown to be a result of a combination of simple geometrical distributions, involving the means and ways of both transporting and depositing.

Three majors " superclasses " have been defined :

- All sizes greater than 2 mm.
- All sizes smaller than 63 μm.
- All intermediate sizes.

The following criterion has been selected for reservoir sediment, as regards the size scale and corresponding nomenclature.

∅ (mm)	Sediment texture
2-0.0625	Sandy
0.0625-0.00395	Silty
< 0.00395	Clayey

The terms sandy, silty and clayey are used to describe the sediment texture rather than the traditional nouns, sand, silt and clay, because the latter set imply a compositional quality.

Nearly all the authors agree that in nature it is extremely unusual to find sediment containing only one grain size. There likewise exists a general consensus that detrital sediment is made up of trimodal ternary mixtures of the independent clastic types, which means there is a need to classify into three components. The sediment study proposed by Shepard (1964) was used in the reservoirs.

3. RESULTS OBTAINED

Table 1 shows the most important data for the reservoirs studied to date by the CEDEX, for the Hydraulic Works Administration. The reservoirs included are listed alphabetically according to the rivers basins to which they belong. The basic data shown are the reservoir volume lost and the sediment texture.

Several bathymetric surveys were conducted in some reservoirs, but only the values for the volume considered to be initial and the figure for the last survey undertaken are included.

The volumes are those for the elevation regarded as the Normal Water Storage (NWS).

Table 1 also indicates the texture of the reservoir sediment, and Fig. 1 shows the sediment composition in the reservoirs studied.

4. FINAL CONSIDERATIONS

4.1. Reservoir capacity loss

An examination of the reservoir capacity loss data from the Tables in the previous section, shows that not only has there been a lack of sedimentation in the years in which some of the reservoirs have been operating, but also that volumes greater than the initial ones are obtained.

Two reasons could explain the latter phenomenon :

First, possible errors in the data for the initial volumes.

Second, permitted margins of error in the photogrammetric and bathymetric methodologies used. This could be the case when the real capacity loss is negligible (≤ 5 %).

4.2. Overall capacity loss

Table 2 shows, by capacity loss intervals, the number of reservoirs in each river basin included in every one of them.

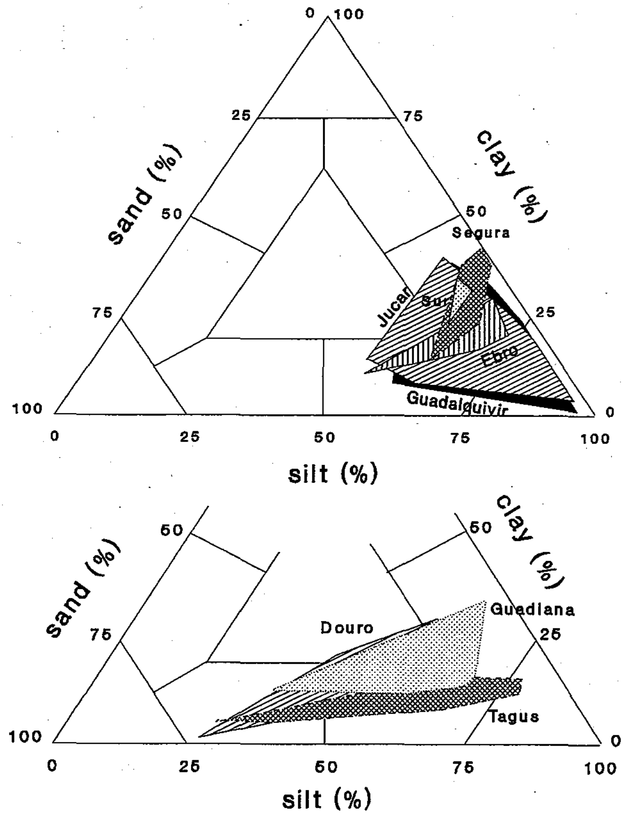

Fig. 1

Textural variation of the reservoirs for the different basins studied

Variation de la texture des sédiments dans les réservoirs pour les différents bassins étudiés

Of all the reservoirs surveyed (101), it should be pointed out that 79 % show a capacity loss below 20 % of their total volume.

It is also significant that 95 % of the reservoirs are below a 50 % silting level. There are only 5 reservoirs whose sediment volume is greater than 50 %. Two of these, Doña Aldonza (98 % silting) and Pedro Marín (94 %), are in the Guadalquivir Basin. Another, the Puentes Reservoir, with 59.3 % silting, is in the Segura Basin. Embarcaderos (84 % volume loss) is in the Júcar Basin and La Estanca de Alcañiz, with a silting level of 51 % is in the Ebro Basin.

TABLE 1

Main data of studied reservoirs

Caractéristiques principales des réservoirs étudiés

H.D. Norte

Reservoir	Height (a.s.l.)	Volumes				Capacity loss				Texture
		Initial		Bathymetry		Total		Annual		
	(N.W.S.)	x10^6 m^3	Year	x10^6 m^3	Year	x10^6 m^3	%	x10^6 m^3	%	
Alfilorios	405.00	9.400	1990	8.406	1994	0.994	10.57	0.249	2.64	
Peñarubia	394.42	12.000	1961	8.212	1994	3.788	31.57	0.115	0.96	
Rioseco	380.50	4.270	1978	3.985	1994	0.285	6.67	0.018	0.42	

H.D . Douro

Reservoir	Height (a.s.l.)	Volumes				Capacity loss				Texture
		Initial		Bathymetry		Total		Annual		
	(N.W.S.)	x10^6 m^3	Year	x10^6 m^3	Year	x10^6 m^3	%	x10^6 m^3	%	
Agueda	636.50	22.000	1931	15.418	1980	6.582	29.92	0.134	0.61	
Aguilar de Campóo	942.00	247.000	1963	-	-	-	-	-	-	Sandy-Clayey-Silt
Barrios de Luna	1108.50	308.000	1956	310.014	1985	-2.014	-0.65	-0.069	-0.02	Clayey-Silt
Burgomillodo	874.18	15.000	1953	12.397	1989	2.603	17.35	0.072	0.48	Silt-Clayey-Sand
Linares del Arroyo	915.30	58.000	1951	55.046	1980	2.954	5.09	0.102	0.18	Clayey-Silt

H.D. Tagus

Reservoir	Height (a.s.l.) (N.W.S.)	Volumes: Initial x10^6 m^3	Initial Year	Bathymetry x10^6 m^3	Bathymetry Year	Capacity loss: Total x10^6 m^3	Total %	Annual x10^6 m^3	Annual %	Texture
Borbollón	321.00	86.000	1954	87.784	1990	-1.784	-2.07	-0.050	-0.06	Silt
Buendía	710.50	1520.000	1957	1520.000	1983	0.000	0.00	0.000	0.00	
Cazalegas	384.14	11.000	1949	6.948	1990	4.052	36.84	0.099	0.90	Silty-Sand
El Burguillo	729.10	208.609	1931	197.673	1991	10.936	5.24	0.182	0.09	
El Torcón	696.00	4.400	1948	3.869	1968	0.531	12.07	0.027	0.60	
El Vado	923.45	57.000	1972	56.309	1979	0.691	1.21	0.099	0.17	Silt
Entrepeñas	720.50	891.000	1956	885.389	1979	5.611	0.63	0.244	0.03	
Gariel y Galán	386.00	924.000	1961	911.160	1990	12.840	1.39	0.443	0.05	Silty-Sand
Guajaraz	606.10	25.000	1971	19.609	1982	5.391	21.56	0.490	1.96	
Pálmaces	885.00	32.000	1954	31.371	1984	0.629	1.97	0.021	0.07	Sandy-Silt
Riosequillo	1005.00	48.500	1956	34.476	1970	14.024	28.92	1.002	2.07	
San Juan	580.00	162.000	1955	137.742	1992	24.258	14.97	0.656	0.40	Sandy-Silt

H.D . Guadiana

Reservoir	Height (a.s.l.) (N.W.S.)	Volumes: Initial x10^6 m^3	Initial Year	Bathymetry x10^6 m^3	Bathymetry Year	Capacity loss: Total x10^6 m^3	Total %	Annual x10^6 m^3	Annual %	Texture
Brovales	303.30	7.000	1960	-	-	-	-	-	-	Sandy-Silt
Cijara	427.90	1670.000	1956	1531.889	1983	138.111	8.27	5.115	0.31	
Gasset	622.12	23.000	1909	23.504	1983	-0.504	-2.19	-0.007	-0.03	Silty-Sand
Peña del Aguila	223.80	8.200	1897	-	-	-	-	-	-	Clayey-Silt
Torre de Abraham	663.56	60.000	1974	56.850	1988	3.150	5.25	0.225	0.38	Sandy-Silt
Valuengo	296.20	20.000	1959	17.869	1985	2.131	10.66	0.082	0.41	Clayey-Silt
Zújar	318.00	309.020	1989	301.898	1994	7.122	2.30	1.424	0.46	

H.D . Guadalquivir

Reservoir	Height (a.s.l.) (N.W.S.)	Volumes				Capacity loss				Texture
		Initial		Bathymetry		Total		Annual		
		x10^6 m^3	Year	x10^6 m^3	Year	x10^6 m^3	%	x10^6 m^3	%	
Aracena	344.00	123.000	1969	126.724	1977	-3.724	-3.03	-0.466	-0.38	
Bembezar	182.50	347.000	1963	342.101	1994	4.899	1.41	0.158	0.05	
Bermejales	829.00	104.000	1958	102.605	1978	1.395	1.34	0.070	0.07	Silt
Bornos	104.00	215.000	1961	200.185	1990	14.815	6.89	0.511	0.24	Clayey-Silt
Cala	278.00	59.000	1927	55.397	1984	3.603	6.11	0.063	0.11	
Cubillas	641.50	21.000	1956	18.701	1990	2.299	10.95	0.068	0.32	Clayey-Silt
Doña Aldonza	341.50	23.000	1955	0.561	1977	22.439	97.56	1.020	4.43	
El Pintado	340.50	202.000	1942	212.835	1995	-10.835	-5.36	-0.204	-0.10	Clayey-Sandy-Silt
El Tranco de Beas	641.50	500.000	1945	496.325	1990	3.675	0.74	0.082	0.02	Sandy-Silt
Gergal	50.00	36.000	1979	34.695	1985	1.305	3.63	0.218	0.60	Sandy-Silt
Guadalcacín	63.60	77.000	1917	65.028	1969	11.972	15.55	0.230	0.30	
Guadalén	349.50	173.000	1954	163.282	1977	9.718	5.62	0.423	0.24	
Guadalmellato	211.50	163.000	1965	146.677	1992	16.323	10.01	0.605	0.37	Clayey-Silt
Guadalmena	600.67	347.000	1969	345.930	1989	1.070	0.31	0.053	0.02	Sandy-Silt
La Bolera	971.40	56.000	1967	53.172	1979	2.828	5.05	0.236	0.42	
La Breña	121.00	116.000	1935	100.131	1991	15.869	13.68	0.283	0.24	Clayey-Silt
La Minilla	159.50	60.000	1956	56.360	1984	3.640	6.07	0.130	0.22	Clayey-Silt
Los Hurones	216.00	138.000	1962	140.000	1969	-2.000	-1.45	-0.286	-0.21	
Negratin	637.50	570.000	1984	573.478	1990	-3.478	-0.61	-0.580	-0.10	Sandy-Silt
Pedro Marín	320.00	19.000	1954	1.107	1977	17.893	94.17	0.778	4.09	
Puente Nuevo	445.00	286.704	1972	281.734	1994	4.970	1.73	0.226	0.08	
Torre del Aguila	51.20	70.000	1947	64.357	1992	5.643	8.06	0.125	0.18	Clayey-Silt

H.D. Sur

Reservoir	Height (a.s.l.)	Volumes				Capacity loss				Texture
		Initial		Bathymetry		Total		Annual		
	(N.W.S.)	x10^6 m^3	Year	x10^6 m^3	Year	x10^6 m^3	%	x10^6 m^3	%	
Conde de Guadalhorce	341.30	77.612	1921	66.561	1991	11.051	14.24	0.158	0.20	
Guadalhorce	362.25	134.400	1972	130.430	1991	3.970	2.95	0.209	0.16	Clayey-Silt
Guadalteba	362.25	149.330	1973	153.360	1991	-4.030	-2.70	-0.224	-0.15	Clayey-Silt
La Viñuela	230.00	170.000	1986	168.201	1994	1.799	1.06	0.225	0.13	Clayey-Silt
Renegado	82.10	1.800	1974	1.646	1992	0.154	8.56	0.009	0.48	

H.D . Segura

Reservoir	Height (a.s.l.)	Volumes				Capacity loss				Texture
		Initial		Bathymetry		Total		Annual		
	(N.W.S.)	x10^6 m^3	Year	x10^6 m^3	Year	x10^6 m^3	%	x10^6 m^3	%	
Alfonso XIII	300.47	42.000	1916	23.816	1985	18.184	43.30	0.264	0.63	Clayey-Silt
Anchuricas (Miller)	894.00	8.000	1957	6.241	1979	1.759	21.99	0.080	1.00	
Argos	413.16	11.722	1970	10.056	1991	1.666	14.21	0.079	0.68	Clayey-Silt
Camarillas	348.62	34.516	1960	34.327	1993	0.189	0.55	0.006	0.02	Clayey-Silt
Cenajo	435.00	472.000	1960	465.597	1992	6.403	1.36	0.200	0.04	Clayey-Silt
La Cierva	385.60	7.500	1929	5.071	1987	2.429	32.39	0.042	0.56	Clayey-Silt
La Fuensanta	605.28	235.000	1933	209.727	1991	25.273	10.75	0.436	0.19	Sandy-Silt
Puentes	447.80	31.560	1884	12.834	1985	18.726	59.33	0.185	0.59	Clayey-Silt
Santomera	100.36	26.386	1965	31.348	1993	-4.962	-18.81	-0.177	-0.67	Clayey-Silt
Taibilla	1032.95	10.000	1973	9.090	1981	0.910	9.10	0.114	1.14	Sandy-Silt
Talave	508.10	47.203	1918	34.859	1993	12.344	26.15	0.165	0.35	Clayey-Silt
Valdeinfierno	687.00	25.000	1897	12.527	1984	12.473	49.89	0.143	0.57	Clayey-Silt

H.D . Júcar

Reservoir	Height (a.s.l.) (N.W.S.)	Volumes				Capacity loss				Texture
		Initial		Bathymetry		Total		Annual		
		$x10^6$ m^3	Year	$x10^6$ m^3	Year	$x10^6$ m^3	%	$x10^6$ m^3	%	
Alarcón	806.00	1111.778	1955	1204.520	1984	-92.742	-8.34	-3.198	-0.29	Clayey-Silt
Alcora	302.50	2.000	1958	1.925	1976	0.075	3.75	0.004	0.21	
Amadorio	127.00	16.550	1960	15.827	1991	0.723	4.37	0.023	0.14	Silt
Arenós	600.00	137.730	1979	136.937	1994	0.793	0.58	0.053	0.04	
Arquillo de San Blas	974.21	22.000	1960	21.035	1988	0.965	4.39	0.034	0.16	Silt
Benageber(Generalisimo)	527.24	228.000	1955	221.337	1992	6.663	2.92	0.180	0.08	Clayey-Silt
Beniarrés	318.00	30.835	1971	27.004	1991	3.831	12.42	0.192	0.62	Silt
Buseo	478.00	8.000	1912	7.193	1980	0.807	10.09	0.012	0.15	Sandy-Silt
Contreras	669.00	872.000	1975	852.405	1994	19.595	2.25	1.031	0.12	Clayey-Silt
Embarcaderos	321.00	9.000	1952	1.461	1983	7.539	83.77	0.243	2.70	Sandy-Silt
Forata	384.20	39.000	1969	37.458	1983	1.542	3.95	0.110	0.28	Clayey-Silt
Guadalest	380.00	16.000	1965	12.992	1989	3.008	18.80	0.125	0.78	Silt
La Toba	1156.35	11.000	1935	8.826	1980	2.174	19.76	0.048	0.44	
María Cristina	142.30	23.285	1920	19.535	1991	3.750	16.10	0.053	0.23	Clayey-Silt
Regajo	405.03	7.000	1959	6.674	1979	0.326	4.66	0.016	0.23	
Sichar	164.00	52.000	1960	49.271	1976	2.729	5.25	0.171	0.33	

H.D . Ebro

Reservoir	Height (a.s.l.) (N.W.S.)	Volumes				Capacity loss				Texture
		Initial		Bathymetry		Total		Annual		
		x10^6 m^3	Year	x10^6 m^3	Year	x10^6 m^3	%	x10^6 m^3	%	
Arguis	960.00	3.000	1938	2.242	1980	0.758	25.27	0.018	0.60	
Barasona	442.67	71.000	1932	46.236	1993	24.764	34.88	0.406	0.57	Clayey-Silt
Cueva Foradada	579.93	28.700	1926	22.083	1992	6.617	23.06	0.100	0.35	Clayey-Silt
Gallipuén	693.46	4.000	1927	3.159	1979	0.841	21.03	0.016	0.40	
La Estanca de Alcañiz	342.00	14.000	1944	6.867	1971	7.133	50.95	0.264	1.89	
Las Torcas	726.43	9.000	1946	5.805	1979	3.195	35.50	0.097	1.08	
La Tranquera	685.50	84.380	1960	84.259	1994	0.121	0.14	0.004	0.00	Clayey-Silt
Mequinenza	121.00	1530.000	1966	1437.178	1982	92.822	6.07	5.801	0.38	
Moneva	614.67	10.000	1939	8.009	1984	1.991	19.91	0.044	0.44	
Oliana	518.30	101.000	1959	85.820	1985	15.180	15.03	0.584	0.58	
Pena	617.03	21.500	1930	17.881	1989	3.619	16.83	0.061	0.29	Clayey-Silt
Ribaroja	70.00	219.000	1969	206.776	1982	12.224	5.58	0.940	0.43	Clayey-Silt
Santa María de Belsué	895.40	13.000	1931	11.258	1980	1.742	13.40	0.036	0.27	Clayey-Silt
Santolea	583.35	48.853	1932	47.002	1993	1.851	3.79	0.030	0.06	Clayey-Silt
Sotonera	417.00	189.000	1963	181.712	1986	7.288	3.86	0.317	0.17	
Talarn-Tremp	500.92	258.000	1916	188.408	1990	69.592	26.97	0.940	0.36	
Yesa	488.78	471.000	1960	450.220	1986	20.780	4.41	0.799	0.17	Clayey-Silt

H.D. Catalonia

Reservoir	Height (a.s.l.) (N.W.S.)	Volumes				Capacity loss				Texture
		Initial		Bathymetry		Total		Annual		
		x10^6 m^3	Year	x10^6 m^3	Year	x10^6 m^3	%	x10^6 m^3	%	
Foix	100.50	6.000	1928	4.842	1983	1.158	19.30	0.021	0.35	
Riudecañas	210.20	3.242	1918	3.060	1981	0.182	5.61	0.003	0.09	Sandy-Silt

TABLE 2

Reservoir sedimentation. Capacity loss

Alluvionnement des réservoirs. Perte de capacité

CAPACITY LOSS "I" IN %	Nº OF RESERVOIRS PER RIVER BASIN										Nº of Reservoirs in the interval	%	% Accumulated
	Norte	Douro	Tagus	Guadiana	Guadalquivir	Sur	Segura	Júcar	Ebro	Catalonia			
I≤5		3	6	3	9	3	3	10	4	1	42	41.6	41.6
5<I≤10	1		1	1	8	1	1	1	2	2	18	17.8	59.4
10<I≤15	1		2	1	2	1	2	1	2		12	11.9	71.3
15<I≤20		1			1			3	2	1	8	7.9	79.2
20<I≤25			1				1		3		5	5.0	84.2
25<I≤30		1	1				1		1		4	4.0	88.1
30<I≤35	1						1		2		4	4.0	92.1
35<I≤40			1								1	1.0	93.1
40<I≤45							1				1	1.0	94.1
45<I≤50							1				1	1.0	95.0
50<I≤55									1		1	1.0	96.0
55<I≤60							1				1	1.0	97.0
60<I≤65													97.0
65<I≤70													97.0
70<I≤75													97.0
75<I≤80													97.0
80<I≤85								1			1	1.0	98.0
85<I≤90													98.0
90<I≤95													98.0
95<I≤100					2						2	2.0	100.0
	3	5	12	5	22	5	12	16	17	4	101		

4.3. ANNUAL CAPACITY LOSS (%)

Table 3 shows the annual capacity loss values for the reservoirs studied according to their respective river basins, specifying those whose annual volume loss is greater than or close to 1 %.

TABLE 3
Reservoir sedimentation. Annual capacity loss
Alluvionnement des réservoirs. Perte annuelle de capacité

RIVER BASIN	Nº OF RESERVOIRS SURVEYED	ANNUAL CAPACITY LOSS (%)	RESERVOIRS WITH SIGNIFICANT A.C.L.
NORTE	3	0.42(1R)	-Alfilorios(arcillas) 2.65% -Peñarrubia 0.96%
DOURO	5	0-0.61	
TAGUS	12	0-0.6(9R)	-Cazalegas 0.9% -Guajaraz 2% -Riosequillo 2%
GUADIANA	5	0-0.42	
GUADALQUIVIR	22	0-0.43(19R)	-Doña Aldonza 4.46% -Pedro Marín 4.09% -Gergal 0.8%
SUR	5	0-0.5	
SEGURA	12	0-0.68(10R)	-Anchuricas 1% -Taibilla 1.125%
JUCAR	16	0-0.6(14R)	-Embarcaderos 2.71% -Guadalest 0.79%
EBRO	17	0-0.6(15R)	-La Estanca de A. 1.89% -Las Torcas 1.06%
CATALONIA	4	0-0.35(3R)	-San Pons 0.91%
	$\sum = 101$		

It can be seen from this Table, that four of the five reservoirs mentioned in the previous sub-section re-appear in this section.

Only the Puentes Reservoir, with an annual capacity loss of 0.58 % is missing from this group.

There are also two reservoirs in the Tagus Basin, the Guajaraz and Riosequillo Reservoirs, with an annual loss of 2 %, that could show signs of silting problems in the future.

In the Cazalegas Reservoir (Tagus Basin) with an annual silting percentage of 0.9 %, there might be an error regarding the initial volume considered, the real capacity loss being much less.

The overall capacity loss (10.6 %) in the Alfilorios Reservoir in the Norte (North) Basin, is due to the original coating of clays deposited in the reservoir basin to make it impermeable. Therefore, the 2.65 % that appears as the annual capacity loss, is not the real percentage.

The rest of those that appear in the Table with an annual capacity loss of 1 %, are borderline cases where potential future silting problems are concerned.

If it is remembered that the reservoirs for which studies were carried out were generally chosen because they were problematic, it can be concluded that the situation regarding the annual capacity loss of reservoirs is promising.

SUMMARY

This paper presents updated capacity data for 101 reservoirs in nine Spanish river basins. The data were obtained by applying two complementary procedures, photogrammetry and bathymetry. Capacity loss for the reservoirs studied is specified in the following way. The original capacity of 5 % of the reservoirs has been reduced by over 50 %. The capacity loss of 79 % of the reservoirs is less than 20 %.

The results of the textural analysis of the sediment deposited in these reservoirs are presented together with the aforementioned data. These analyses reveal that sediment in the reservoirs in the Ebro, Segura, Júcar and Guadalquivir, together with the rivers constituting the Sur (South) Basin, is of a silty, silt-clayey or silt-sandy texture. In the remaining basins, the sediment grain-size is more varied.

RÉSUMÉ

Ce rapport présente les données actualisées relatives à la capacité de 101 réservoirs situés dans neuf bassins fluviaux espagnols. Les données ont été obtenues en appliquant deux méthodes complémentaires : photogrammétrie et bathymétrie. La perte de capacité des réservoirs étudiés a été déterminée : la capacité initiale de 5 % des réservoirs a diminué de plus de 50 %; la perte de capacité de 79 % des réservoirs est inférieure à 20 %.

On présente les résultats des analyses de texture des sédiments déposés dans ces réservoirs, avec les données susmentionnées. Ces analyses montrent que les sédiments des réservoirs des bassins des fleuves Èbre, Segura, Júcar et Guadalquivir, ainsi que des rivières situées dans le bassin du Sud de l'Espagne, sont de texture silteuse, silteuse-argileuse, ou silteuse-sableuse. Dans les autres bassins, la granulométrie des sédiments est plus variée.